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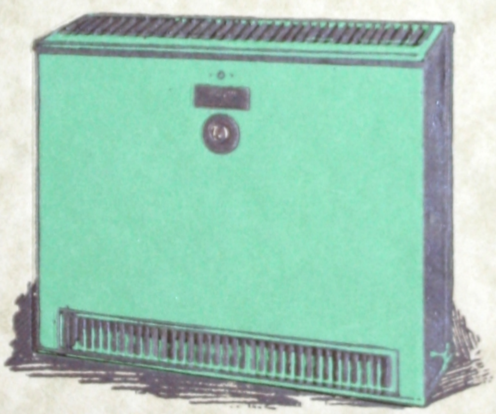
PEERVENT
Heating and Ventilating Units



PEERLESS UNIT VENTILATION COMPANY
INCORPORATED

Give them uniform heating and plenty of fresh air

PEERVENT

Heating and Ventilating Units

for Schools, Libraries, Hospitals, Churches, Club Rooms, Dormitories, Theaters, Banks, Factories, Offices, Auditoriums, and other Buildings

December 1st, 1925

PEERLESS UNIT VENTILATION CO., INC.
Skillman Avenue and Hulst Street
Long Island City, N. Y.

PeerVent Heating and Ventilating Unit

Modern Schoolroom Heating and Ventilating

NOTE: While this booklet deals especially with the heating and ventilation of schools, it should be borne in mind that the PeerVent Unit System is equally suitable for use in hospitals, libraries, churches, dormitories, club rooms, theaters, banks, offices, auditoriums, and other buildings where many people congregate

THE intelligent cooperation of school superintendents, school boards, architects, and engineers, as well as building contractors and manufacturers of equipment, has led to big improvements in school construction during the past few years.

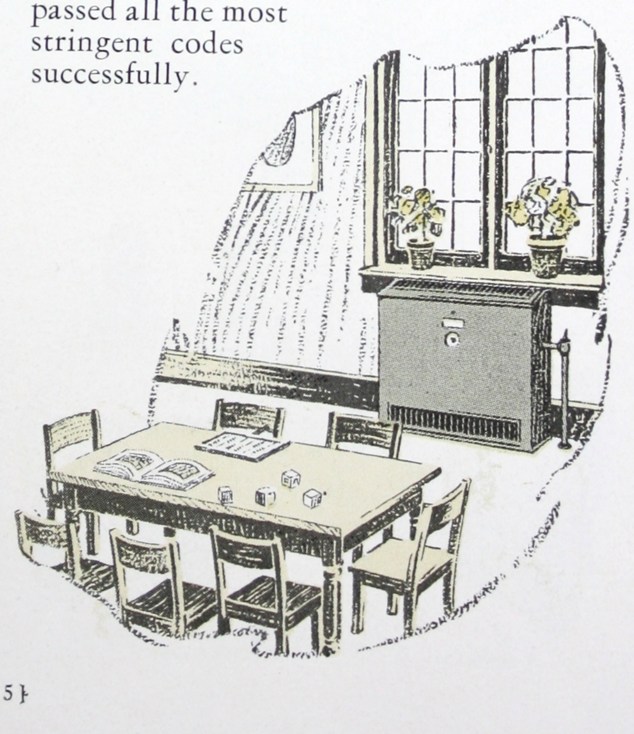
Of these improvements none were more needed than adequate methods of heating and ventilating. School ventilation is especially important because the children attend for many years, for several hours every day, during the formative periods of their lives. The subject should be considered—and nowadays, as a rule, it is—in the light of the most recent research, supplemented by the teachings of experience.

Dullness, sluggishness, and lassitude, both mental and physical, are the well-known direct and quickly noticeable effects of bad ventilation, and both teachers and children suffering from it are especially susceptible to colds, sore throats, tonsilitis, bronchitis, and even tuberculosis. Such ailments cause incalculable losses in time and school work, losses which may have far-reaching effects in many lives.

Aside from all other considerations, efficient schoolroom heating and ventilating pays big dividends in more effective teaching effort and increased ability to think and study on the part of pupils.

It is obvious that the unit system of heating and ventilating, whereby each room is heated and ventilated separately and exactly as needed, offers great advantages in economy, flexibility, and convenience. These advantages have been demonstrated time and again under actual operating conditions. The economy of the unit system is especially important. Each room gets exactly the desirable volume of air—at exactly the right temperature—and when the room is unoccupied both heating and ventilating can be suspended in a second.

The PeerVent Heating and Ventilating Unit, described and illustrated on the following pages, fully meets the requirements of the various state codes for ventilation of school buildings. It has passed all the most stringent codes successfully.



Operation of the PeerVent Heating and Ventilating Unit

SCHOOLROOM heating and ventilation naturally go together in a climate having great variations of temperature, with cold weather during a large part of the school year. The PeerVent Unit, therefore, is designed to heat as well as ventilate, and a separate unit of suitable capacity is provided for each room.

Operation of the PeerVent Unit is extremely simple. Pure fresh air from out-of-doors is drawn into the unit by two multi-blade fans through an opening provided in the side wall of the building, usually directly beneath a window. This opening is protected by stationary louvres which keep out rain and snow, and by a grille which keeps out birds, leaves, and coarse foreign matter.

The fans, driven by a direct-connected slow-speed noiseless motor, drive the fresh air first through a filter and then through a radiator of special design which heats the air to required temperature. At times part or all of the incoming air is by-passed around the radiator, the proportions heated and by-passed being controlled by a mixing damper. This damper can be operated by hand or automatically by a thermostat. It permits a wide range of temperature regulation, from the point at which all incoming air passes through the radiator to the other extreme when all of the incoming air is driven through the by-pass.

At all intermediate settings of the air-mixing damper the heated and unheated air currents are thoroughly mixed in the unit before being discharged vertically to the room. The air is discharged with sufficient velocity to insure thorough diffusion.

It is possible to shut off entirely the flow of air from out-of-doors and at the same time to start a recirculation of air within the room. This recirculation is effected by means of interconnected dampers, one damper shutting off the opening to the outer air while the other damper opens a passage at the bottom (front) of the unit. These dampers can be operated by hand by means of a key, or by pneumatic switch control from a remote point.

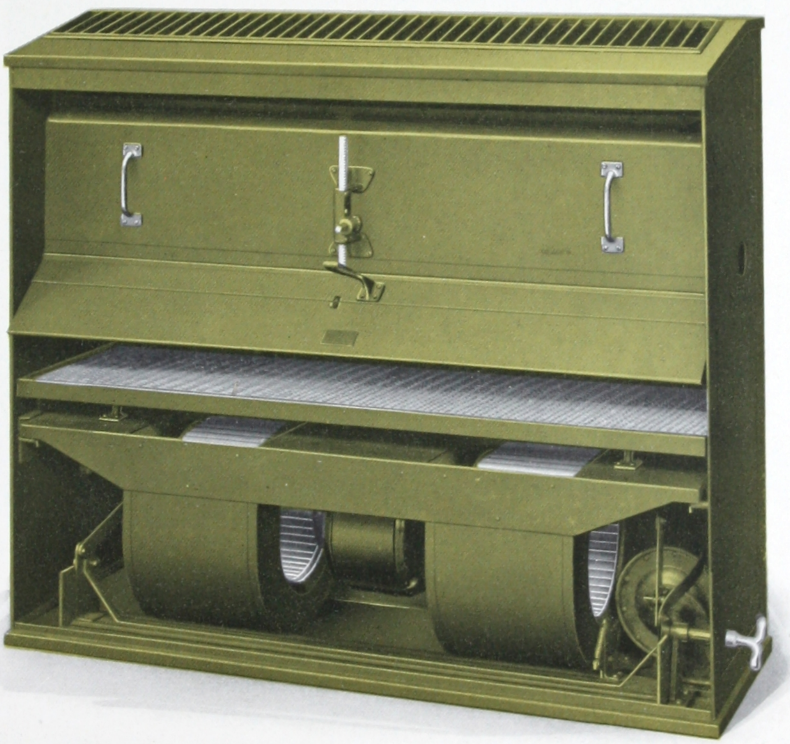
When the room is unoccupied the fresh air inlet damper can be closed (thereby opening the recirculating damper) and the radiator in the unit used for such limited heating as is then desirable. The motor and fans need not be operated during the periods of vacancy, or until just before the pupils arrive, when the room temperature can be brought up to normal quickly by starting the fans and recirculating the air in the room. As soon as the pupils arrive the unit dampers are set to operate normally and to deliver the re-

quired cubic feet per minute of heated fresh air.

The steam valve of the PeerVent radiator is kept open constantly and should be of the lock shield type, with key, to prevent tampering. Manipulation of these valves is neither necessary nor desirable, as all control of the room temperature is effected by the air-mixing damper. With the damper in the cold position and outside air between 60° and 70° F., the PeerVent Unit will by-pass all the air around the radiator and discharge it at a temperature increase not exceeding two degrees.

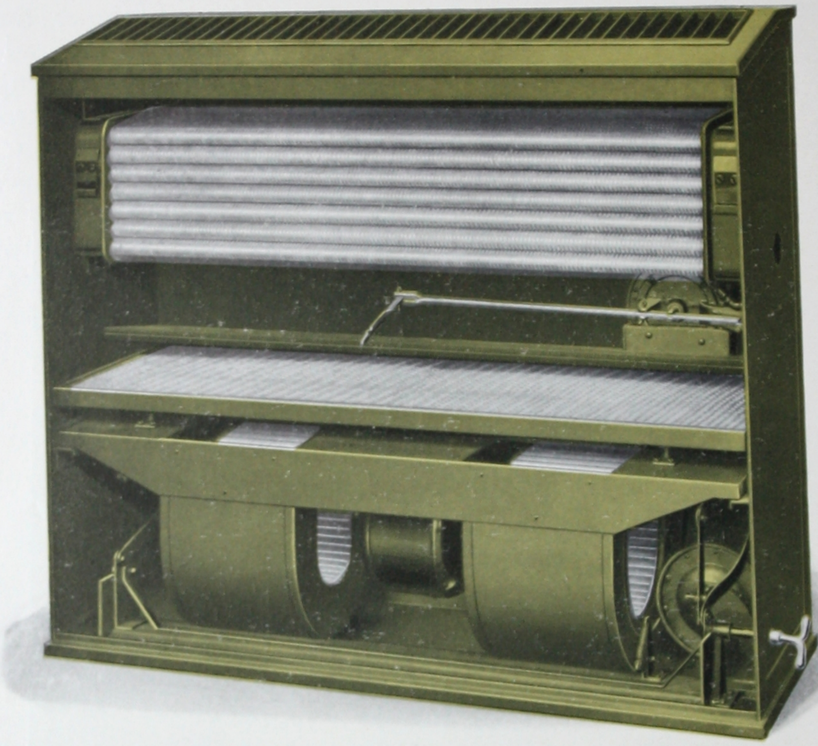
PeerVent Units are commonly used in addition to ordinary radiators. This is known as the "split" system and is recommended. Under all ordinary operating conditions the PeerVent Units will supply sufficient heat, and the direct radiation is employed only in extremely cold weather or when for any other reason the heating capacity of the PeerVent Units is insufficient to take care of an unusual condition.

While PeerVent Units can be furnished for operation by hand, automatic control of the mixing damper and pneumatic control of the fresh air and recirculation dampers is rapidly gaining favor. The automatic control is secured by a compound thermostat, which controls the mixing damper of the unit by graduated action and the direct radiators by positive action. When a room becomes too cold, the mixing damper is set to pass all incoming air through the radiator in the unit and the compound thermostat automatically opens the valves controlling the direct radiation, the latter remaining open only long enough to bring the room temperature up to normal.



PeerVent Unit with front plate removed. In this view the mixing damper is in position to pass all incoming air through the radiator.

Mechanical Features of the PeerVent Heating and Ventilating Unit



PeerVent Unit with front plate and mixing damper removed. The other easily removable parts, beginning at the top, are (1) the radiator, (2) air filter, (3) motor and fan unit, and (4) the base assembly, which includes the fresh air and recirculating dampers and the pneumatic device by which the janitor can operate these dampers from the basement.

THE PeerVent Unit is remarkably compact. It is only 36 inches high, designed to fit under a window in most cases, without obstructing light or interfering with the use of the window. As it is only 14 inches deep, it also occupies very little floor space.

The various parts which make up a PeerVent Unit are standardized, interchangeable, and very easily removable. No tools are required to take the unit apart and the work can be done in a very few moments, First, the complete front cover is removed, then the mixing damper, next, the complete fan assembly, including motor, then the base assembly, which supports the connected recirculating and fresh air dampers, and finally the radiator itself. The whole job can be done very quickly, even by one who is inexperienced, and reassembling is just as easy and just as quickly accomplished. Parts for units of the same capacity are perfectly interchangeable.

Semi-concealed-type PeerVent Units can be furnished when required, as shown in various illustrations in this booklet. In this construction the entire unit is set into the wall of the room, so that the front of the unit is flush with the wall, and the

unit occupies no space whatever in the room. The outlet into the room from this type of Unit is placed about eight feet above the floor. See details on page 25.

The Peerfin radiator, one of the features which make the compact PeerVent Unit possible, is without doubt the most efficient radiator that has been developed for use in ventilating units. It consists of seamless copper tubing around which is wound and fastened a helical extended surface of copper fins. The number of tubes can vary in units of different capacities from 21 to 49. The tubes are mechanically fastened into brass headers. The helical fins serve to increase the radiating surface of the tubes, at the same time causing air passing through the radiator to circulate across the tops and bottoms of the tube surfaces, as well as past the sides. This construction increases the efficiency of the radiator fully 12 per cent. The steam and return headers are supported from the sides of the casing in a rigid manner, so that the fitter who connects up the unit to the steam lines cannot twist the radiator or the unit out of shape. The Peerfin Radiator is assembled in the Company's own factory, subject to rigid inspections and tests.

Four standard types of control are available for the PeerVent Unit System, as follows:

Control A. All dampers hand operated.

Control B. Mixing damper hand and pneumatically operated. Fresh air and recirculating dampers hand operated only.

Control C. All dampers hand and pneumatically operated.

Control D. Fresh air and recirculating damper pneumatic and hand operated and the mixing damper hand operated only.

Galvanized iron wall boxes, for the air passages leading from out-of-doors to the PeerVent Units, are furnished as standard equipment with stationary louvres and stamped steel grilles. Copper wall boxes and bronze grilles, either cast or stamped, can be furnished if specified.

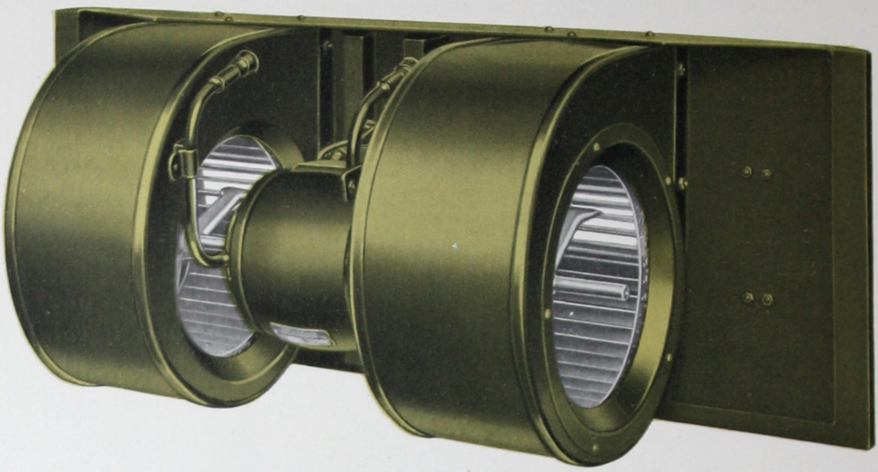
The PeerVent cabinet is constructed of 14-gauge stretcher-leveled resquared metal furniture stock, full pickled, and the standard finish is a handsome olive-green baked enamel. Other colors can be furnished to match interior finishes if required. Inside as well as outside surfaces are enameled, including mixing damper, fan housing, etc.

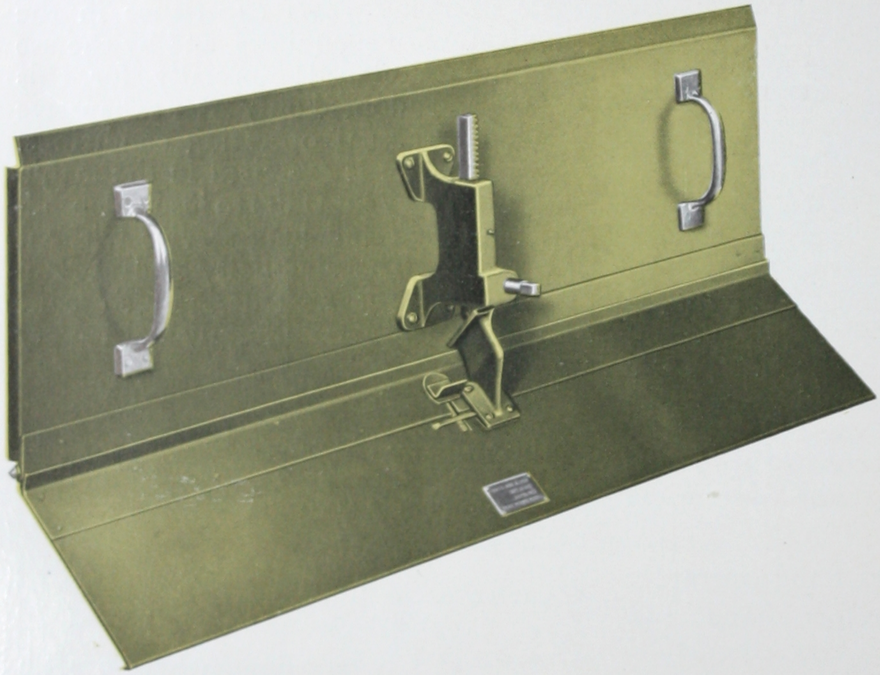
Remarkable quietness of operation is achieved in the PeerVent Unit as the result of many years experience in the manufacture of such units, and by the use of motors designed especially for this purpose and adopted only after exhaustive tests under actual operating conditions.

Extreme care is exercised in the manufacture of PeerVent Units to insure dependable operation and long service without expert care. The simplicity and accessibility of the PeerVent design also make for trouble-free and uniformly satisfactory service.

The PEERVENT Heating and Ventilating Unit

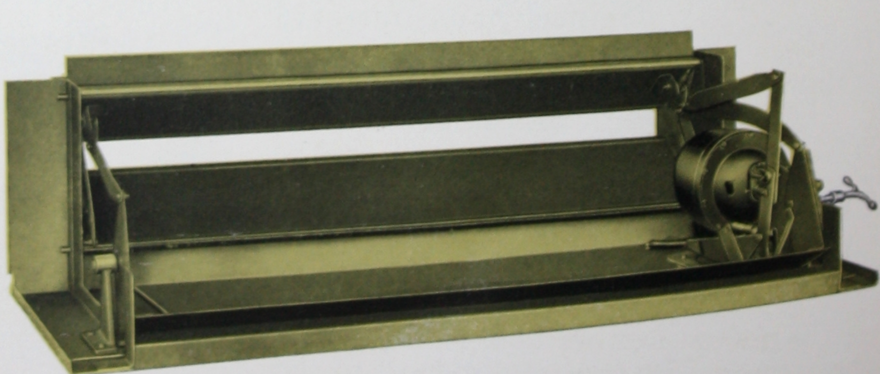
PeerVent motor and fan assembly. Like all other PeerVent parts, can be removed from the unit in a moment, without tools. Various sizes of fans are furnished, depending on the capacity of the unit. See pictures on pages 7 and 15.





The picture at the left shows the PeerVent mixing damper. The lower part swings back and forth (under hand or automatic control). In the position shown here (see also page 7) the mixing damper causes all the incoming air to pass through the radiator. If the damper is swung downward some air is allowed to bypass around the radiator, and if swung back as far as it will go the damper causes all incoming air to be bypassed and there is no appreciable heating effect.

At the right is the base assembly of the PeerVent Unit, including the fresh air and recirculating dampers and the pneumatic device by which the janitor can operate these dampers from the basement.



Advantages of the PeerVent Unit System of Heating and Ventilating

Independent service for each room at a cost proportioned exactly upon the useful work done: The PeerVent System provides for each room a unit exactly proportioned to the needs of that room, with ample flexibility to meet the demands of changing weather conditions. The heating and ventilating effect is absolutely positive, and it is produced as perfectly in a room that is seldom used as in one that is in continuous use. One room may be naturally colder than another. The PeerVent System of Units makes it possible to properly ventilate any room and at the same time to maintain the right temperature in each room regardless of its exposure.

Each PeerVent Unit is entirely independent and the operating expense is per room and proportional to the demands of that room per unit of time.

This is the ideal ventilating and heating condition. All expense for ventilating unoccupied rooms is eliminated, without in any way interfering with conditions in the used portions of the building. The cost of operation is the smallest of any system of mechanical ventilation, and the efficiency throughout is not dependent upon guesswork in the original design.

Thorough ventilation without drafts: Although the volume of air discharged by a PeerVent Unit is large and ample, and the velocity through the unit high enough to insure proper results, the air is so directed vertically into the room that only imperceptible currents are created—harmless but effective. A desk can be placed close to a PeerVent Unit without discomfort or risk to the occupant from the incoming fresh air.

Noiseless operation: The motor and fans are wholly enclosed and the steel platform on which they are mounted is insulated with sound-absorbing felt cushions.

Always in working order: Nothing in the PeerVent Unit is subject to wear except the motor bearings. These are of high grade phosphor-bronze, practically frictionless, and fitted with ring lubrication which needs attention only occasionally. All internal parts are easy of access, although the duty on the mechanism is so light that wear is negligible.

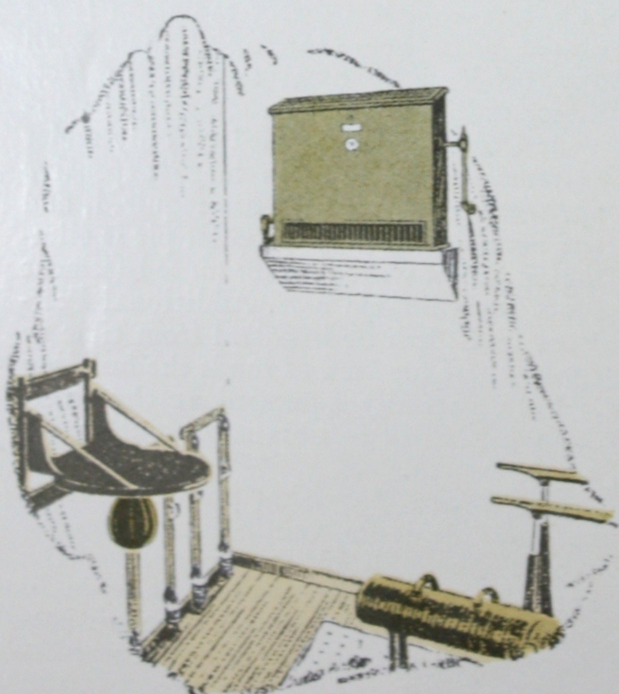
No user has yet encountered mechanical difficulties with PeerVent units.

Effects big space and cost savings in new buildings: The PeerVent Units occupy little more space than ordinary radiators, and less direct radiation is required with PeerVent Units than with any other mechanical system. In fact, direct radiators in the rooms with PeerVent Units need be turned on only under extreme conditions. No large expensive apparatus room and fan are required, and the necessity for a deep boiler pit is eliminated, all of which means more basement space for valuable uses. Additional PeerVent Units can be installed from time to time, where for lack of funds the building is only partially equipped at the start. Such flexibility is obtainable only with a unit system.

No special provision for ventilation need be made in the building design, except the small air inlet openings. The PeerVent System requires no built-in or sheet metal ducts, flues, or warm-air passages. The entire absence of such construction not only saves much expense but also

eliminates big heating losses between the heating chamber and the rooms to be ventilated. In addition to saving in building construction and materials, space, and fuel, the absence of ducts also eliminates a most objectionable lodging place for dust, dirt, germs, and vermin, and reduces fire and panic risk by doing away with passages through which smoke and fire in the basement can get into the upper rooms.

Ideal for old buildings: No remodeling is necessary to produce the same efficiency as obtainable in a new building. If an existing system fails in some particular room, a PeerVent Unit can be added to make good the shortcomings, or the entire existing system can be supplanted by PeerVent Units at minimum expense. When sections or wings are added to a building, the ventilating and heating of the new rooms merely require the installation of more PeerVent Units, without over-drain or impairment of the efficiency of the ventilation system in the older parts of the building. Only with the unit system is such flexibility obtainable.



The electric motor control of each PeerVent Unit, as well as the fresh-air and recirculating dampers, can be connected with remote control electric and pneumatic systems, so that every unit in the building can be operated from switches at a single central station located in the basement. The advantages of this arrangement are obvious. All the attendant has to do is start and stop the units. He is neither responsible for nor able to impair the correctness of their operation. The control is exact and insures room temperatures always at the required degree and without varying the quantity of air *for ventilation.*

Advantages of the Unit System Over the Central Fan System

THERE are no unsightly ducts to take up space, waste heat, and collect dust when not in use.

An open window in one room cannot change the quantity and temperature of air delivered to every other room. Each room is heated and ventilated independently of all others.

There are no volume dampers to adjust; instead, a unit of known factory-tested capacity is selected to suit the particular room to be served.

The amount of fresh air supplied to the whole building cannot be affected by such a detail as the speed of a single motor. If trouble of any kind occurs in a central system, the ventilation of the whole building is affected, whereas if trouble should occur in a PeerVent Unit (no user has ever had mechanical trouble) it obviously could not affect any room except the one in which the unit is located.

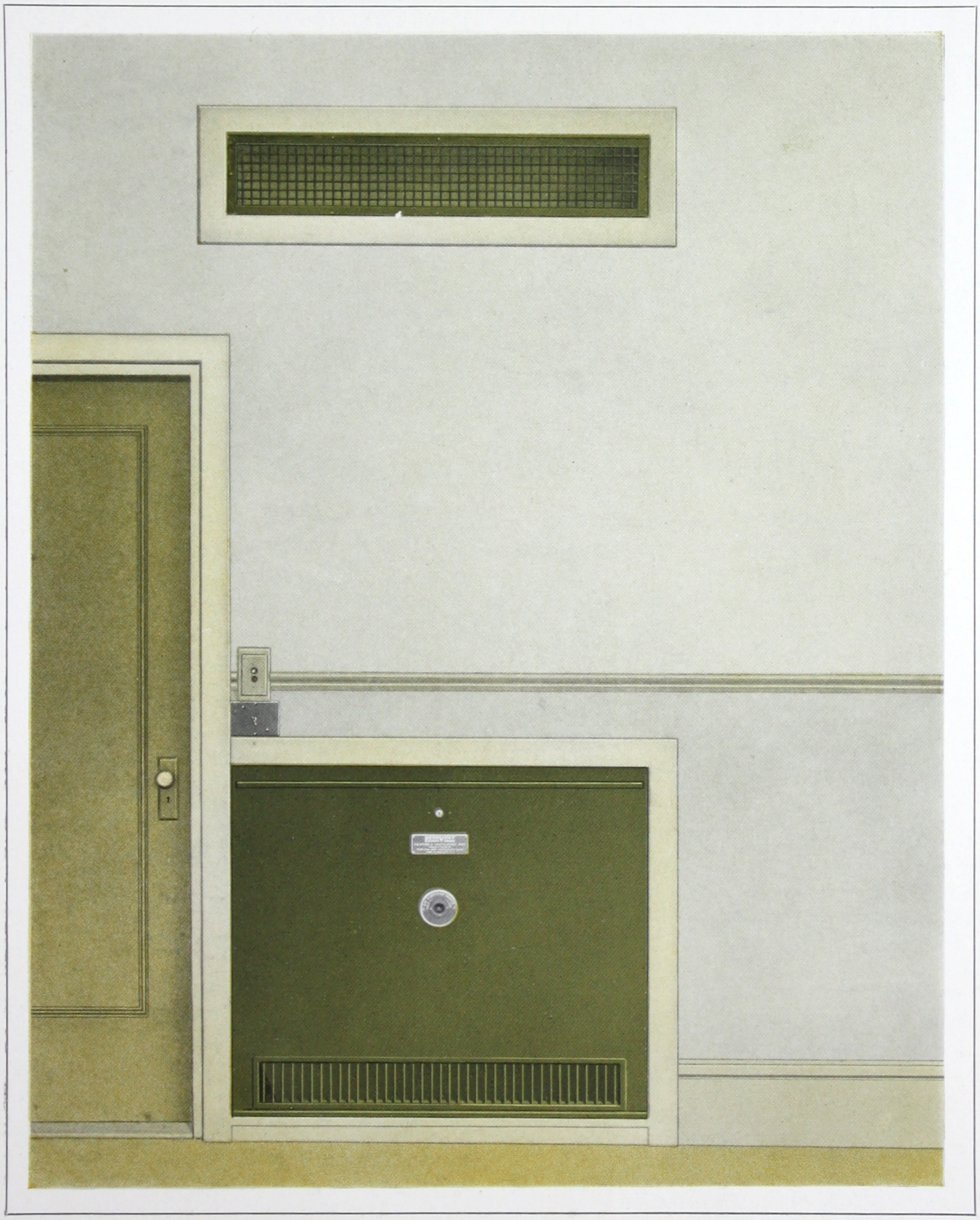
Rooms with unusually cold exposure, or subject temporarily to unusually cold winds, can be given extra warmth without effect on other rooms less exposed.

Each unit can be automatically controlled to maintain a certain temperature

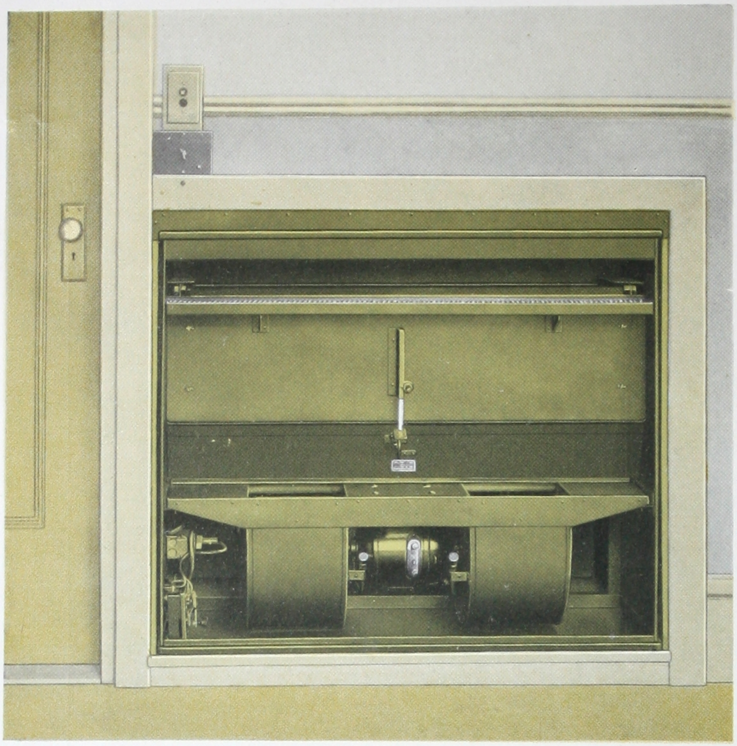
in the one room where it is located and need not be disturbed by hand operation.

Cost of operation is based entirely on useful work done in each particular room. The unit can be shut off instantly when the room is unoccupied, thus saving coal.

The cost of electric current for operating a number of PeerVent Units is far less than for operating a single large fan and duct system.

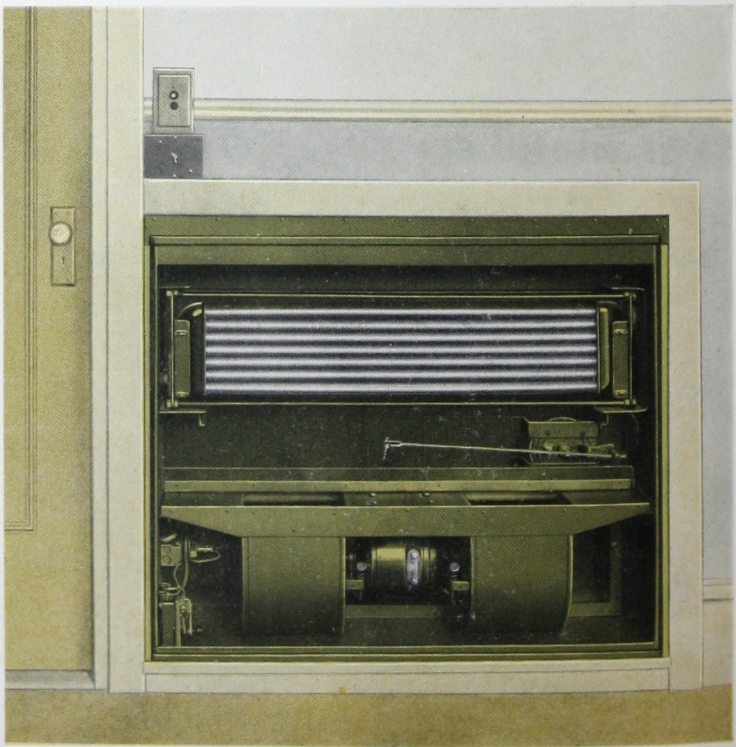


Semi-Concealed PeerVent Unit with fresh-air grille about eight feet above the floor (see drawing on page 25). The front plate of the unit is flush with the wall.



The picture at the left shows a semi-concealed type of PeerVent Unit with front plate removed. The mechanism is practically the same as in the standard unit (page 7). Note that in this view the mixing damper is set to bypass all incoming fresh air around the radiator.

In this picture (right) the mixing damper has been removed to show the radiator. All of the parts in the Semi-Concealed PeerVent are quickly removable, without the use of tools, like those in the Standard Unit. Various sizes of fans and radiators can be furnished, depending on the capacity of the unit.



Facts Concerning Installation of PeerVent Units

Quantity of ventilating air: The quantity of ventilating air to be furnished is limited more by practical considerations than by theoretical requirements. As much fresh air as possible should be supplied, keeping in mind that the circulation should not be so strong as to constitute a draft and that the greater the supply the greater the cost of providing it.

The standard which has been adopted as a fairly adequate supply is 30 cubic feet of air per capita per minute. This standard was first determined by the State of Massachusetts and is now generally recognized throughout the country as minimum for school ventilation.

Automatic control of schoolroom heating and ventilating has many advocates. Their claims in general are that more perfect uniformity can be maintained with automatic control, as it is not subject to the whims, carelessness, and ignorance of any chance operator.

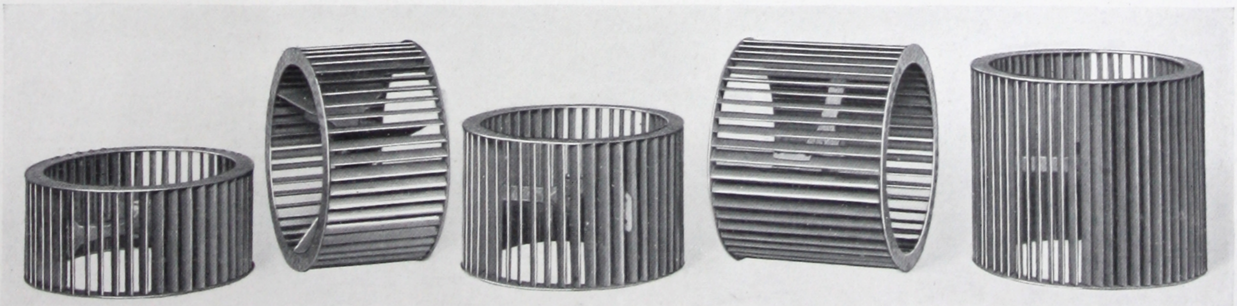
Both effectiveness and efficiency are apt to suffer in a hand-controlled heating system, it is claimed, the waste of fuel is always greater, and there is more trouble in maintaining perfect running condition. An automatic system permits thorough tests to be conducted by an expert to determine the best operating conditions, and then suitable setting to produce such conditions continuously.

Automatic heating and ventilating control devices have been developed to a degree of mechanical excellence that assures in practice all the theoretical advantages that favor their adoption. These devices usually consist of thermostats located in each room and actuating, through compressed air, diaphram motors which control the mixing dampers of the heating and ventilating units and diaphram valves controlling the direct radiation.

The installation cost of an automatic regulating system amounts to such a small percentage of the cost of the heating and ventilating system that more and more engineers are recommending the additional expenditure on the grounds that it is well repaid by increased effectiveness of the entire system.

Shipment and erecting: Each PeerVent Unit is shipped completely assembled. Our service men erect the units in place complete, ready for steam and electric connections, which assures satisfactory installation.

Engineering service: Every installation of the PeerVent Unit System of Heating and Ventilating is made the subject of individual engineering attention, in order



Fans used in various sizes of PeerVent Units.

that all requirements will be met to best advantage and with lowest subsequent operating expense.

Our engineers are always ready to cooperate with the architect or engineer in furnishing data for the compilation of specifications, and our service men are sent to the job to make the installation and assist the operating attendant in becoming familiar with the apparatus.

Information required with inquiries: To aid in determining the most serviceable apparatus and in submitting estimate of cost, blue print sections and elevations of the building should if possible be sent to us, together with statement of the kind of steam heating system to be used, whether direct or alternating current is available, also voltage, cycles, and phase, and the maximum number of occupants expected in each room to be ventilated. Where plan and elevation drawings are not available, the dimensions of rooms, including height of ceiling and the location and size of doors, windows, shafts, and stairways, should be given.

The standard floor type of unit is the most efficient, but where slight sacrifice of efficiency is secondary to architectural conditions or the desire to hide the heating and ventilating apparatus, concealed or semi-concealed units can be used. Installation of these types costs somewhat more because of additional grille work, art sheet metal, special fittings, etc.

With a view to insuring quietness, it is recommended that only direct current or two or three-phase alternating current should be used for ventilating unit motors. The magnetic hum of single-phase motors makes them undesirable for this purpose.

Where local current is single-phase alternating, it is advisable to install a motor-generator outfit in the basement to supply direct current to the ventilating units.

PeerVent Unit installation is flexible and can as a rule be adapted to special architectural requirements.

An important feature of the PeerVent System is its ready adaptability to old buildings. Typical installations of this kind are shown on pages 18 to 21. It is only necessary to provide an opening for the air intake and to make the steam and electric connections.

PeerVent Units are adaptable to all steam conditions and give perfect results in connection with any low-pressure, vapor, vacuum, gravity, or modulation steam heating system.

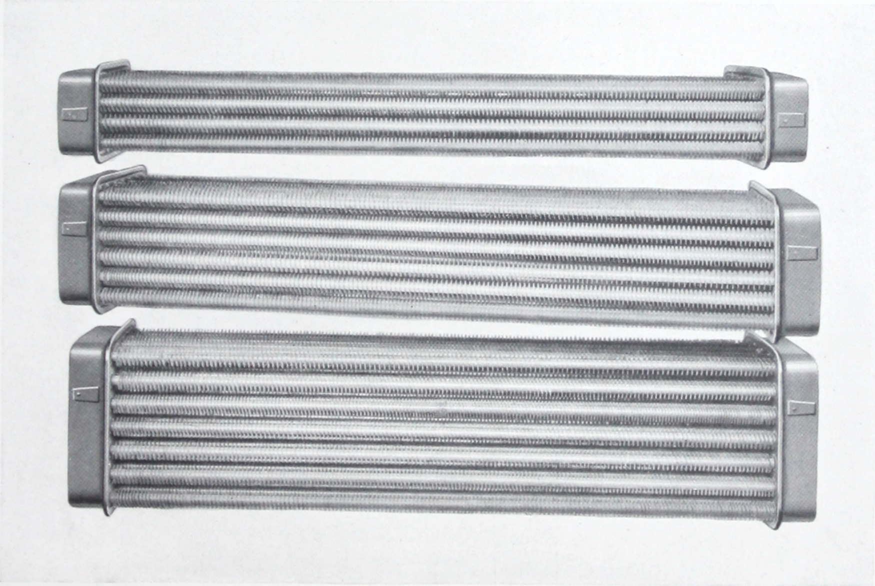
Various air filters can be used in connection with PeerVent Heating and Ventilating Units, although they are not included as standard equipment and should be covered by specifications.

Architects: Lappley and Hornbostel, Harrisburg, Pa. *Contractors: Herre Brothers, Harrisburg, Pa.*
John Harris High School, Harrisburg, Pa.

Directions for Laying Out the PeerVent Unit System of Heating and Ventilating

FIRST determine the amount of air required for ventilation, figuring on 30 cubic feet per minute per pupil in the classrooms, and from four to six changes per hour for the assembly hall, gymnasium, etc. The latter rooms usually require more than one PeerVent Unit.

The size of units having been determined from the above information and the data on page 22, the location of units and the method of making the fresh air inlet should have next consideration. Naturally, the unit should be placed where the greatest heat losses occur, which is usually at a window, because of infiltration of air through cracks and heat transmission through the glass. If more than one PeerVent Unit is needed in a given room, the radiation in each should be proportioned to the space served.



Three of the various sizes of radiators used in PeerVent Units.

Radiation: To determine the amount of direct radiation required, compute radiation in the usual way (pages 35 to 40) and then deduct the amount shown on page 22 for the PeerVent Unit chosen. The remainder is the amount that must be added in direct radiation.

A room can be heated by the PeerVent Unit alone, but the practice of omitting direct radiation is not recommended, because if for any reason the electric current is shut off and the fan kept out of operation the room cannot be heated properly.

No unit on the market contains enough radiation to heat the average size class room *when the fans are inoperative* without the aid of some direct radiation. Experience has shown that PeerVent Units with their fans inactive have the heating usefulness indicated in the table on page 22, and no more than the amount of direct radiation given in the table should be omitted for each PeerVent Unit.

Vent flues and grilles: It is evident that if a ventilating unit introduces a certain amount of air into a room, some provision must be made to remove that same amount of vitiated air. Three ways of doing this are:

1. Venting through an independent flue, located in the cloak room. This is the most satisfactory way of venting class rooms. Air from the class room passes into the cloak room through a grille in the lower panel of the door between the rooms and out into a flue to a point above the roof (see page 30). This method dries and removes the offensive odor of wet clothing in the coat room on rainy days, and ventilates and heats the cloak room without necessity of placing any radiation there.

2. Venting through independent flues in the class rooms. This procedure is desirable only for rooms that do not have independent coat rooms.

3. Venting through the corridor and into a main vent flue located in the corridor. This method is used only in old buildings that have no provision for ventilation and in some states does not meet legal requirements.

The following sizes of grilles and flues are recommended for class rooms:

No. of pupils	Cubic feet of air per minute	Total area of grille in square feet	Sectional area of flue in square feet
30	900	3	2
40	1200	4	3
50	1500	5	4

See tables of vent flues, page 49. All vent flues should have dampers near the roof and controlled by chains or pneumatic

John Porter School, Easton, Pa.—an old building equipped recently with PeerVent Heating and Ventilating Units.

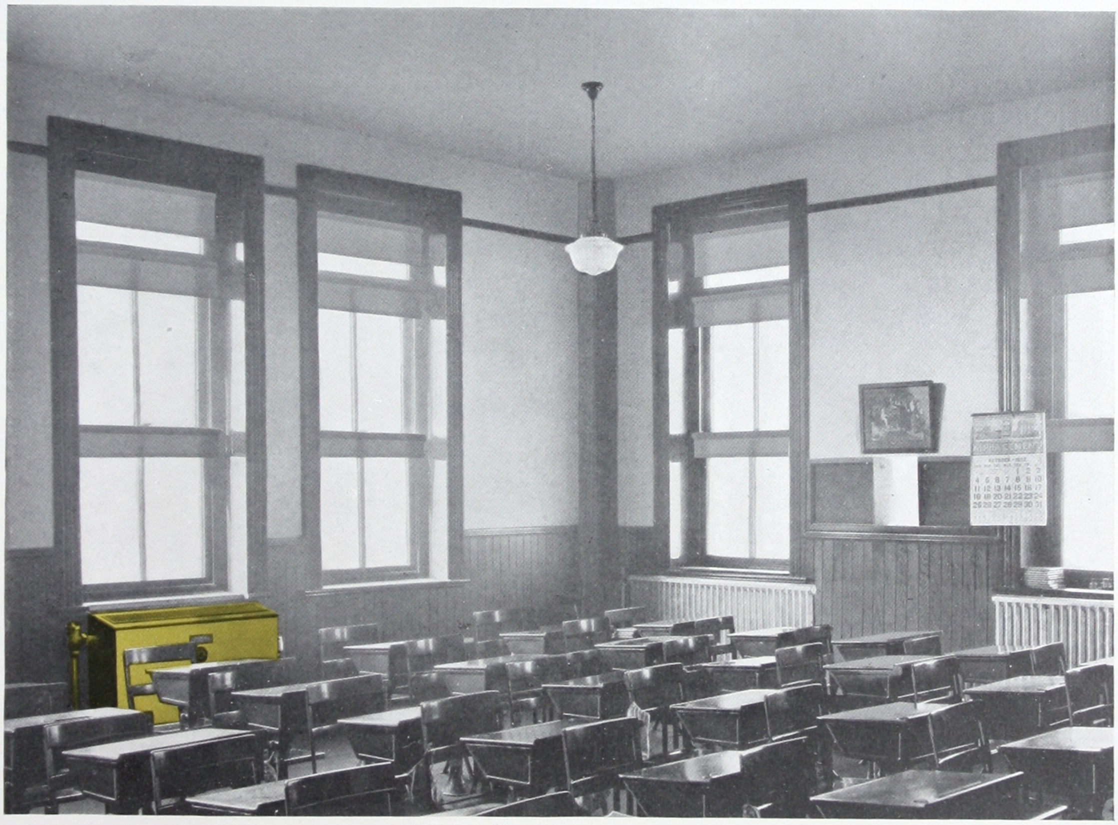
motor, the controls where possible extending to the basement.

Hoods and louvres should be provided over the flue outlets to keep out rain and snow. The vent flues in buildings containing attics can terminate in the attic, which can be vented by means of any reliable make of roof ventilator.

Motor-Generator: In schools and other buildings where noiseless operation is essential, direct current or polyphase alternating current motors are used to drive the unit fans. In localities where no direct or polyphase current is available, a motor-generator set is installed to furnish direct current to the unit motors. The motor-generator is located at some point in the basement where free from ashes, dust, dirt, and tampering by pupils.

Any reliable make of motor-generator can be used with the PeerVent Unit System of Heating and Ventilating. The table on page 23 will assist in determining the size required.

Guarantees: Every PeerVent Unit is guaranteed to be free from material and workmanship defects, and further guaranteed, when installed and operated as directed, to heat the room or space served to a temperature of 70 F. in zero weather. With the motor in operation, the Unit is guaranteed to furnish 30 cubic feet of air per minute for each occupant of the room when the latter is filled to its intended capacity, and in every way to meet the heating and ventilating requirements of the State and Local Boards of Education. The Company is responsible, backed by years of successful experience and by a large number of satisfactory installations.



One of the rooms in the John Porter School, Easton, Pa., equipped with a PeerVent Heating and Ventilating Unit. The PeerVent System can be installed as easily in old buildings as in new.

Typical Endorsement of the Unit System

AT a meeting held in May, 1923, in the office of the Board of Education of New York City, that body unanimously voted to depart from the existing Central Supply Split System and adopt the Unit System of Heating and Ventilation for future school buildings of the city.

The reasons which prompted the City Architect, the Committee on Buildings and Sites, and the Superintendent of Schools to recommend the change in heating and ventilating methods were:

"To eliminate large and expensive apparatus which at times is idle. The installation of the Unit System will effect a saving of from 5 to 10 per cent, which represents approximately from $3,000 to $7,000 per building, depending on the size and type.

"The Unit System would obviate large apparatus rooms, underground ducts, and deep basements, thus effecting a saving of not less than 8 per cent, which on a 48 classroom building would amount to approximately $50,000 to $60,000.

"To eliminate heavy heat losses between central heating chambers and rooms.

"To reduce fire and panic risks, by doing away with passages for smoke through ducts, should fire occur in basement.

"A room may be ventilated only when occupied; thus each room becomes an individual system.

"To allow rooms for after-hour use to be ventilated separately, whereas in a central system it becomes necessary to operate entire plant to serve individual rooms.

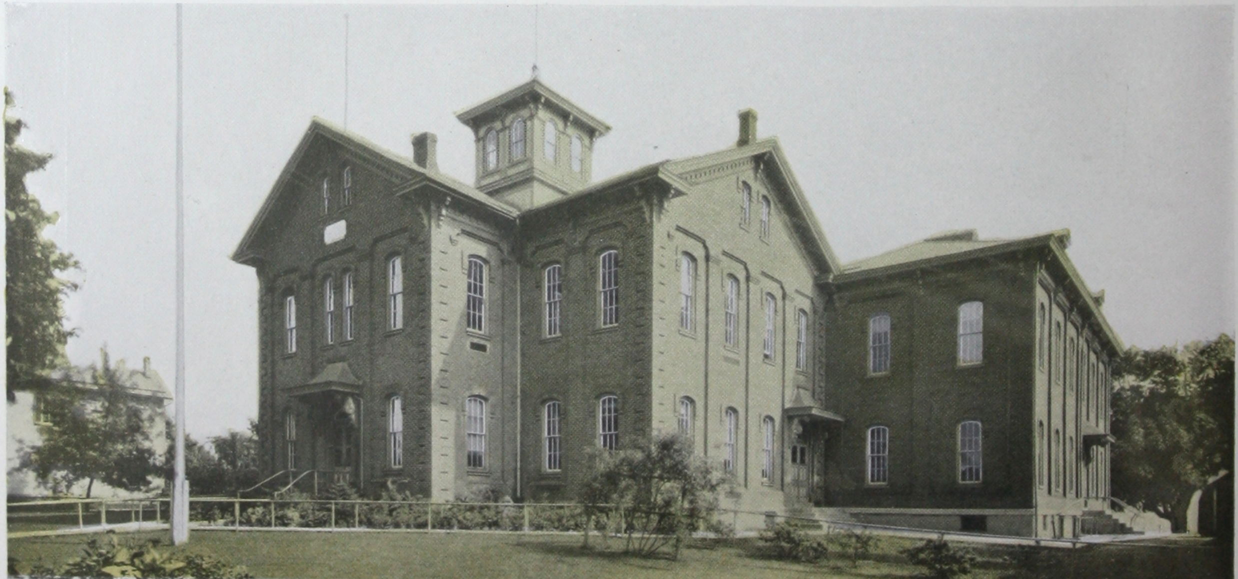
"To allow for quick heating by recirculation.

"The unit becomes a direct radiator for night use by closing out-door damper and opening recirculating damper.

"To eliminate expense of ventilating unoccupied rooms.

"Direct radiators in same rooms with units become operative only in extremely cold weather.

"To decrease motor horse-power for volume discharged, eliminating loss due to duct resistance.



Public School, Catawassa, Pa., another old building equipped recently with the PeerVent Unit System of Heating and Ventilating.

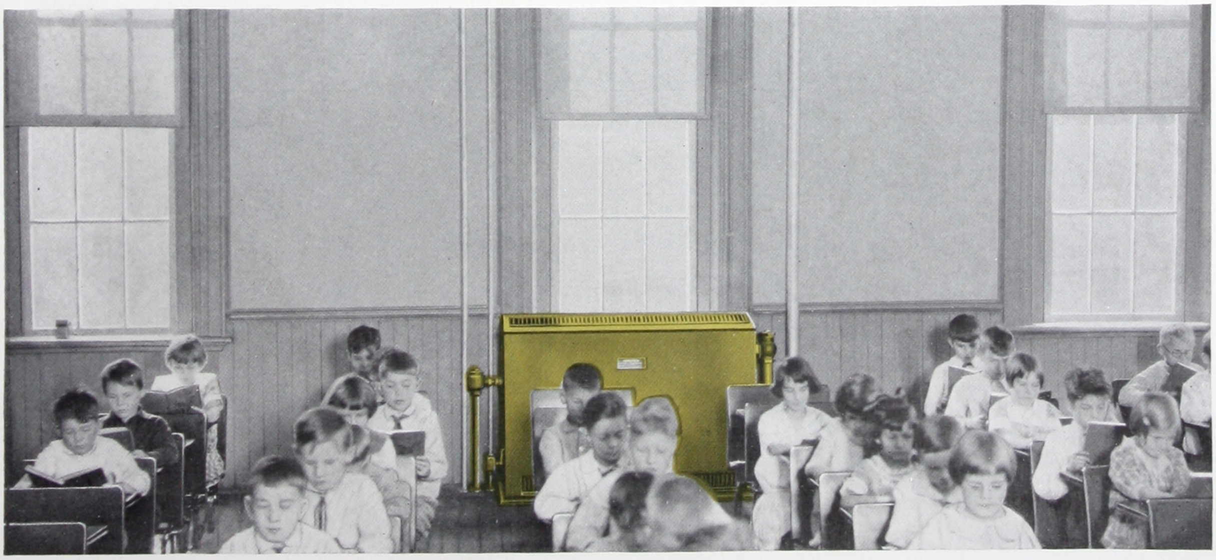
The PEERVENT Heating and Ventilating Unit

"A room can be ventilated or recirculated at will, with the psychological effect of seeing the source which makes possible the bringing of fresh air directly into the room."

The recommendations in favor of the Unit System of Heating and Ventilating were made after inspection and investigation by City Officials of unit systems in operation in neighboring cities and states.

Also private practicing architects and engineers who are experts on school buildings and architects connected with Boards of Education in various cities were consulted and a large majority of these endorsed the Unit System.

A room in the Catawassa, Pa., School, showing how the PeerVent Unit was installed without disturbing existing direct radiation.



Another room in the Catawassa, Pa., Public School.

Engineering Data

PeerVent Heating and Ventilating Units

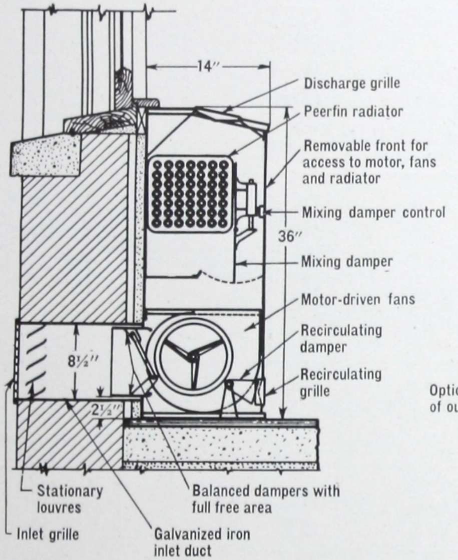
UNIT No.	Maximum Number of Pupils	Maximum Cu. Ft. per Minute	Entering Air at −10°			Entering Air at −0°			Entering Air at +10°			Entering Air at +20°		
			Final Outlet Temperature	Condensate in lbs. per hr.	Omitted Direct Radiation in sq. ft.	Final Outlet Temperature	Condensate in lbs. per hr.	Omitted Direct Radiation in sq. ft.	Final Outlet Temperature	Condensate in lbs. per hr.	Omitted Direct Radiation in sq. ft.	Final Outlet Temperature	Condensate in lbs. per hr.	Omitted Direct Radiation in sq. ft.
46271	20	600	70	63	....	73	56	8	79	52	25	85	48	41
46272	23	700	70	73	....	72	65	6	78	60	26	84	55	45
46273	26	800	76	90	22	82	83	44	88	78	66	94	72	88
46274	30	900	84	111	58	91	105	87	96	97	107	102	91	132
46275	33	1000	91	133	96	97	124	123	104	118	156	108	108	174
46276	35	1050	96	146	125	101	136	149	107	128	178	112	118	202
46361	36	1100	70	115	....	73	103	15	79	95	45	85	88	76
46362	38	1150	70	121	....	72	106	10	78	98	42	84	91	74
46363	40	1200	76	134	33	82	126	66	88	117	100	94	109	132
46364	41	1250	84	154	80	90	145	120	96	135	149	102	126	183
46365	43	1300	91	172	135	97	161	161	104	153	203	108	140	227
46366	45	1350	96	188	161	101	175	192	107	165	229	112	152	260
46451	46	1400	70	147	....	73	131	19	79	121	58	85	112	97
46452	48	1450	70	152	....	72	134	13	78	124	53	84	114	93
46453	50	1500	76	169	41	82	158	83	88	147	124	94	136	165
46454	51	1550	84	191	100	90	180	149	96	168	185	102	156	228
46455	53	1600	91	212	154	97	199	198	104	188	250	108	173	279
46456	58	1750	96	244	209	101	226	249	107	213	297	112	197	338

Engineering Data

PeerVent Heating and Ventilating Units

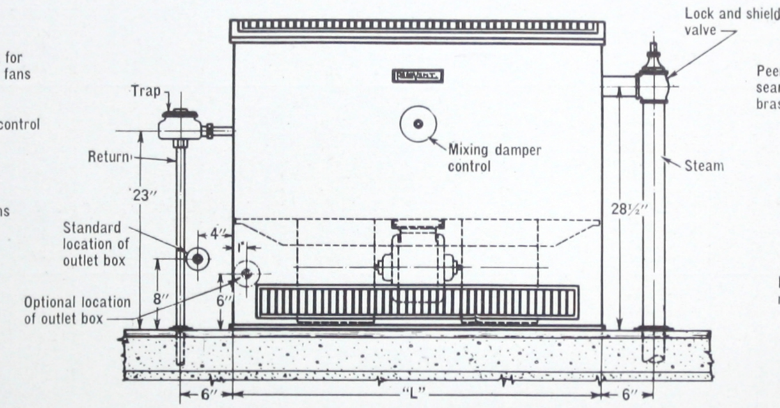
UNIT No.	Maximum Number of Pupils	Maximum Cu. Ft. per Minute	Dimensions (Height .... 36″, Depth .... 14″): Length L	Dimensions: Fresh Air Intake 8½″ x B: B	Approximate Shipping Weight of Unit Lbs.	Power Consumed in Watts	Piping Data — Steam and Return—5¼″ from Back of Unit: Height from Floor: Steam	Height from Floor: Return	Steam Size: Gravity System	Steam Size: Vacuum System	Return Size: Gravity System	Return Size: Vacuum System
46271	20	600	33″	27½″	275	81	28½″	26⅜″	1½″	1¼″	1″	¾″
46272	23	700	33″	27½″	275	85	28½″	26⅜″	1½″	1¼″	1″	¾″
46273	26	800	33″	27½″	290	94	28½″	26⅜″	1½″	1¼″	1″	¾″
46274	30	900	33″	27½″	295	107	28½″	24″	2″	1½″	1″	¾″
46275	33	1000	33″	27½″	300	120	28½″	24″	2″	1½″	1″	¾″
46276	35	1050	33″	27½″	310	135	28½″	23″	2″	2″	1″	¾″
46361	36	1100	42″	36½″	310	90	28½″	26⅜″	2″	1½″	1″	¾″
46362	38	1150	42″	36½″	310	111	28½″	26⅜″	2″	1½″	1″	¾″
46363	40	1200	42″	36½″	320	120	28½″	26⅜″	2″	1½″	1″	¾″
46364	41	1250	42″	36½″	330	129	28½″	24″	2″	2″	1″	¾″
46365	43	1300	42″	36½″	340	138	28½″	24″	2″	2″	1″	¾″
46366	45	1350	42″	36½″	350	147	28½″	23″	2″	2″	1″	¾″
46451	46	1400	51″	45½″	375	172	28½″	26⅜″	2″	2″	1″	¾″
46452	48	1450	51″	45½″	375	183	28½″	26⅜″	2″	2″	1″	¾″
46453	50	1500	51″	45½″	385	192	28½″	26⅜″	2″	2″	1″	¾″
46454	51	1550	51″	45½″	395	201	28½″	24″	2″	2″	1″	¾″
46455	53	1600	51″	45½″	400	210	28½″	24″	2″	2″	1″	¾″
46456	58	1750	51″	45½″	410	243	28½″	23″	2″	2″	1″	¾″

Details of Standard PeerVent Unit

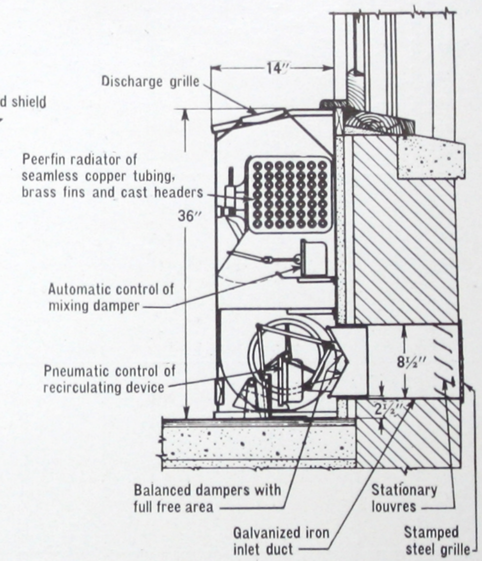


CROSS SECTION

Mixing damper under hand control



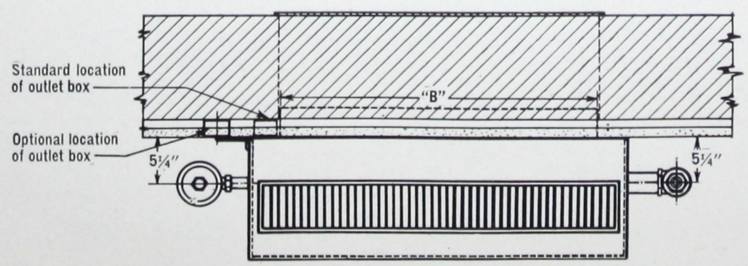
FRONT ELEVATION



CROSS SECTION

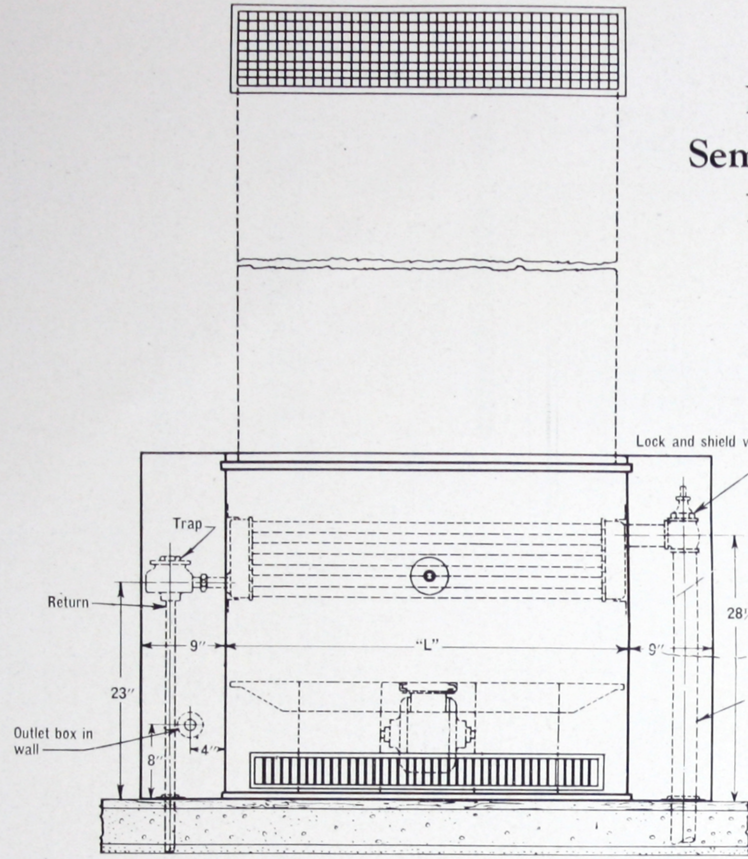
Mixing damper under automatic control and pneumatic control of recirculating device

NOTE.—Electric outlet box will be located on details as shown for standard. When optional location is required, same must be specified on order.



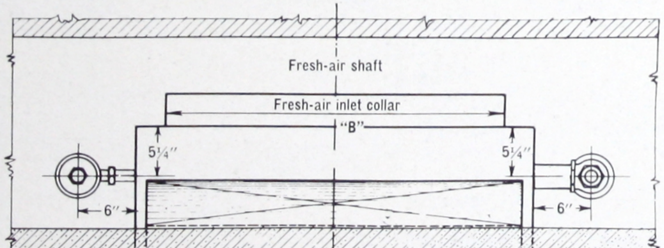
PLAN

Details of Semi-Concealed PeerVent Unit

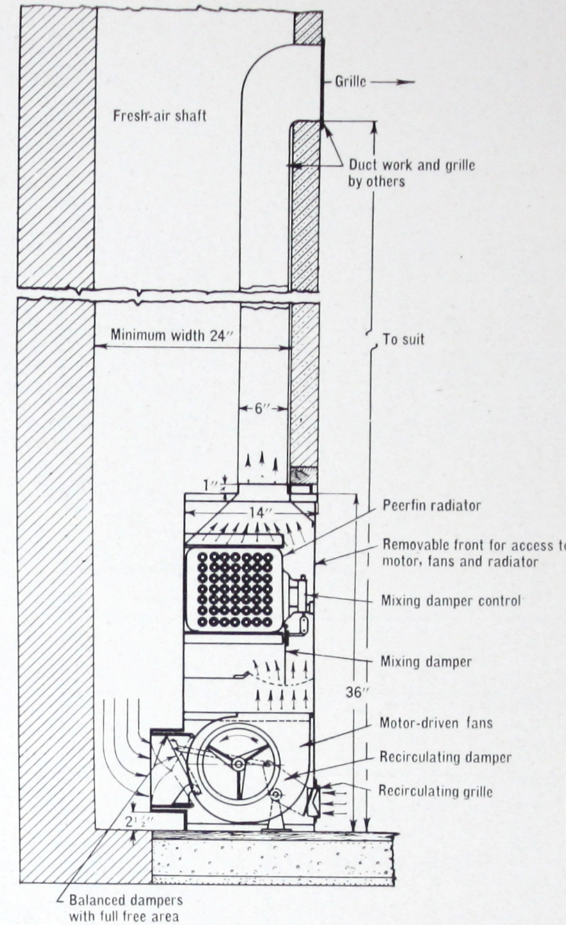


FRONT ELEVATION

Showing extended front for access to steam and return valves



PLAN

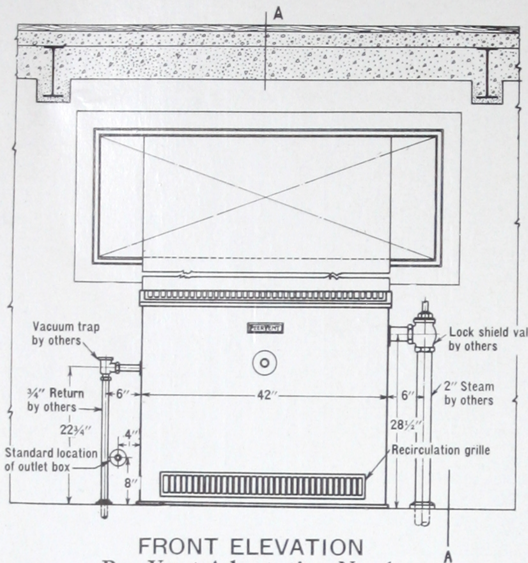


CROSS SECTION

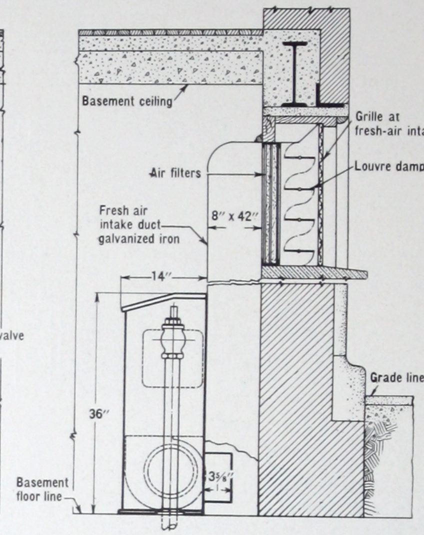
Details showing semi-concealed type unit
Front of unit exposed

Adaptable to inside room requiring ventilation
Fresh air taken from roof

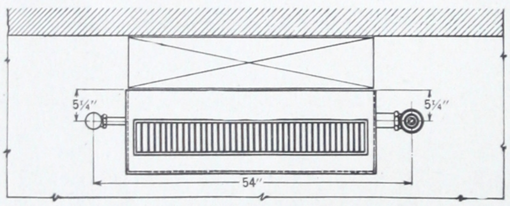
The PEERVENT Heating and Ventilating Unit

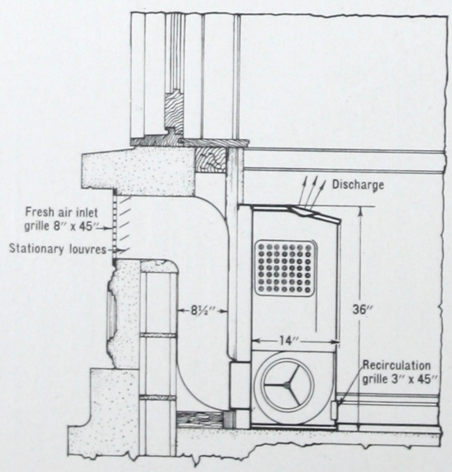


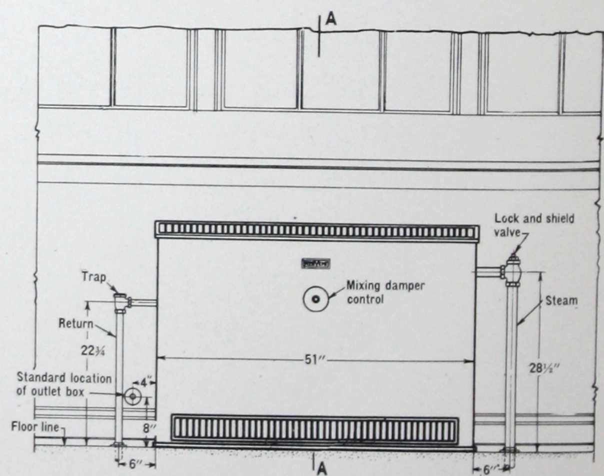
FRONT ELEVATION
PeerVent Adaptation No. 1
Where PeerVent is below grade line



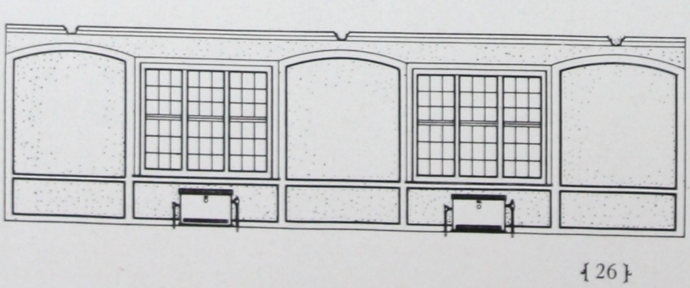
SECTION
On Line AA



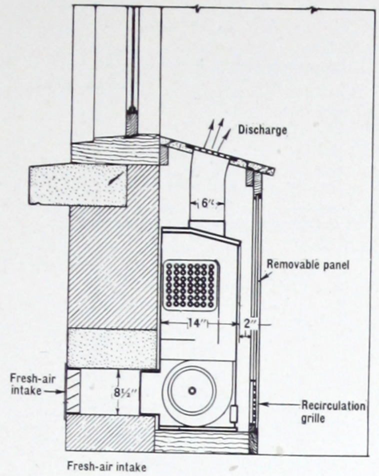




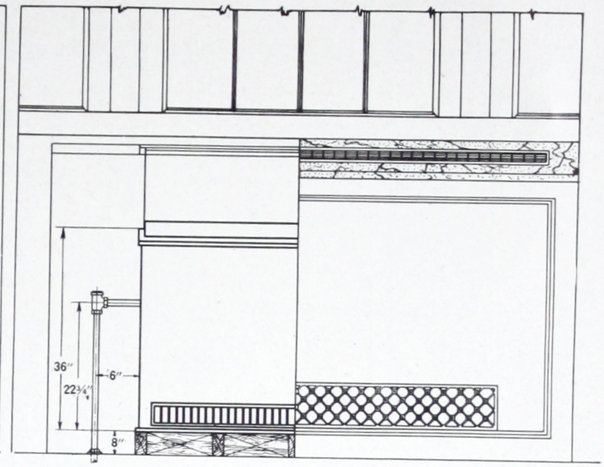
FRONT ELEVATION
PeerVent Adaptation No. 2
Where PeerVent is located below window sill



The PEERVENT Heating and Ventilating Unit



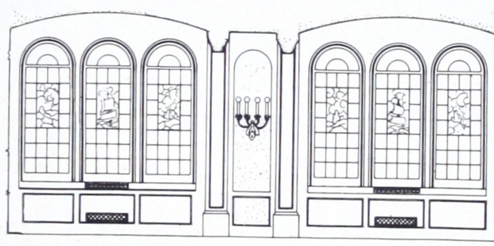
SECTION



ELEVATION

PeerVent Adaptation No. 3

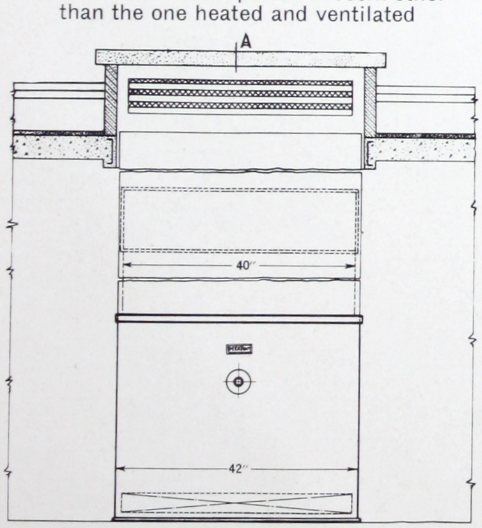
Where PeerVent is Concealed

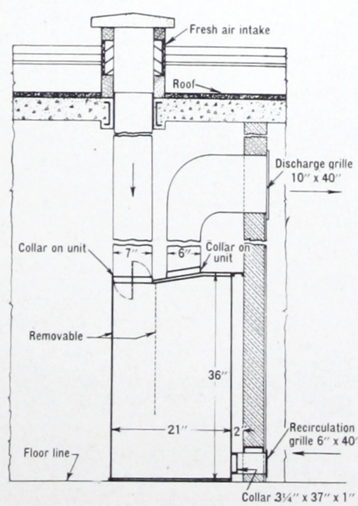


A typical elevation of an Auditorium that is heated and ventilated by concealed PeerVent Units

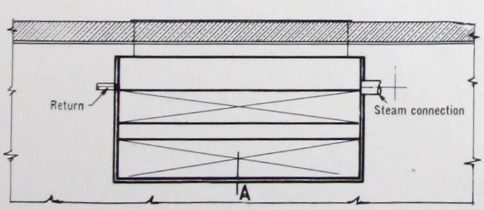
PeerVent Adaptation No. 4

Where PeerVent is placed in room other than the one heated and ventilated

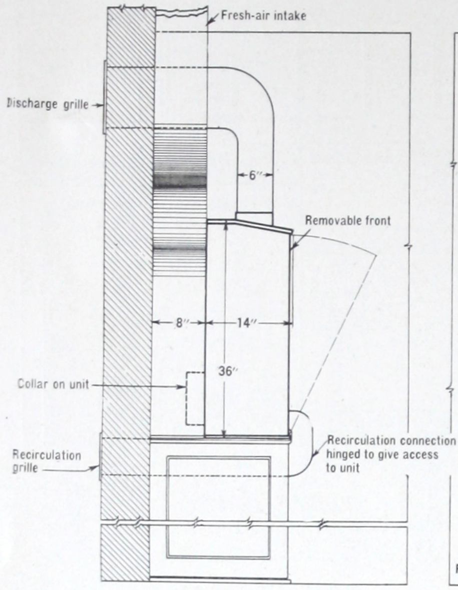




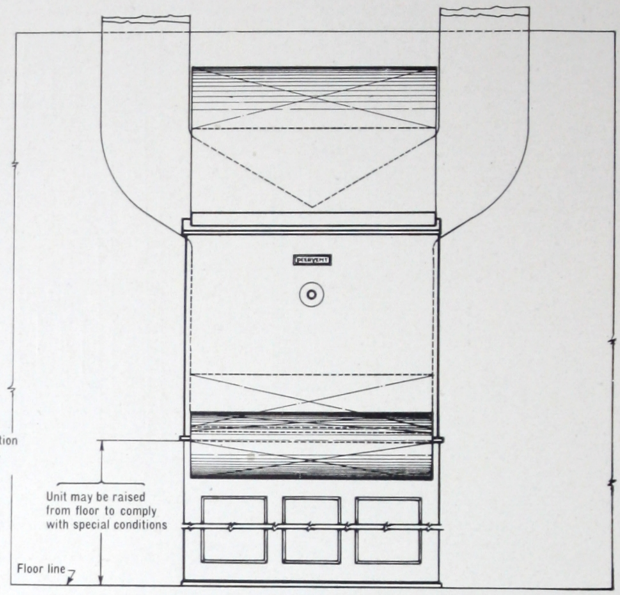
SECTION ON LINE AA



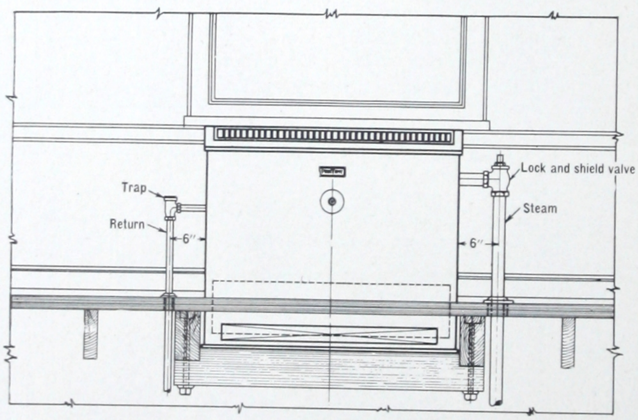
The PEERVENT Heating and Ventilating Unit



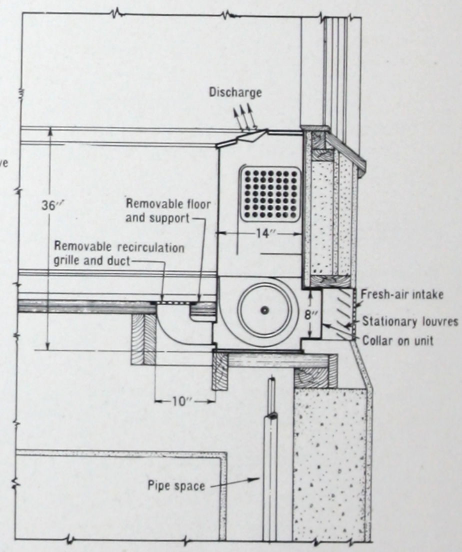
SIDE ELEVATION



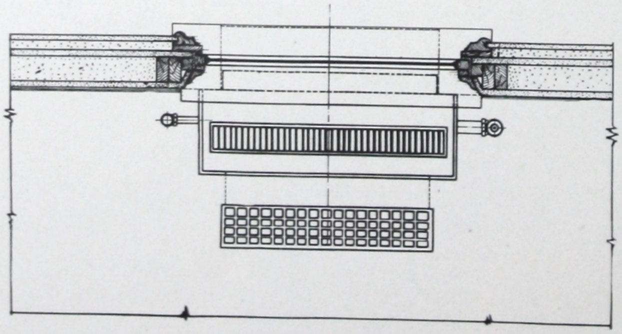
ELEVATION
PeerVent Adaptation No. 5



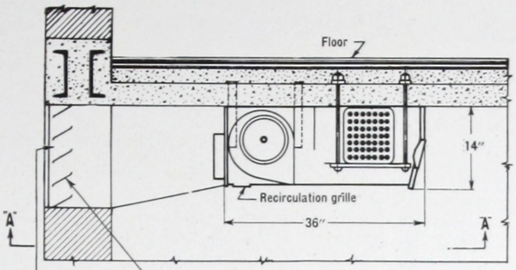
ELEVATION
PeerVent Adaptation No. 6



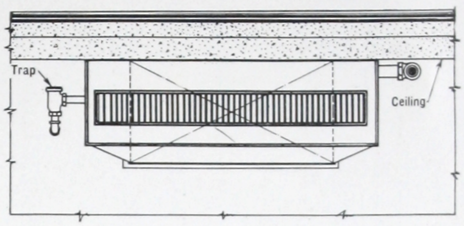
SECTIONAL ELEVATION



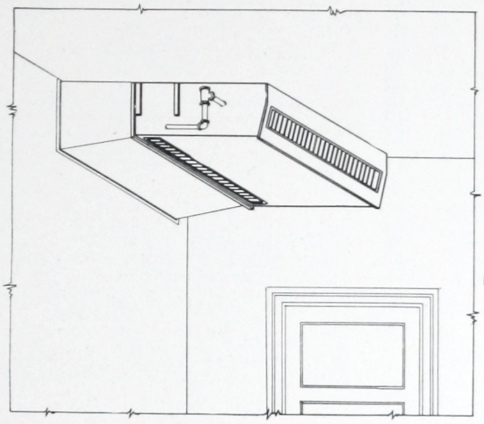
PLAN
PeerVent Installation Adapted to Low Window Height



SECTIONAL ELEVATION



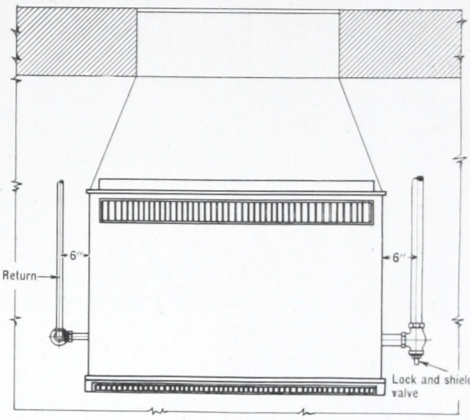
FRONT ELEVATION



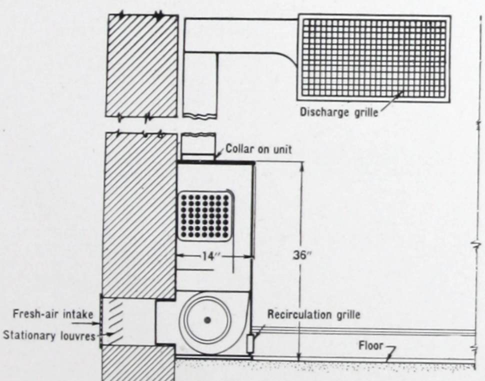
ELEVATION

PeerVent Adaptation No. 7

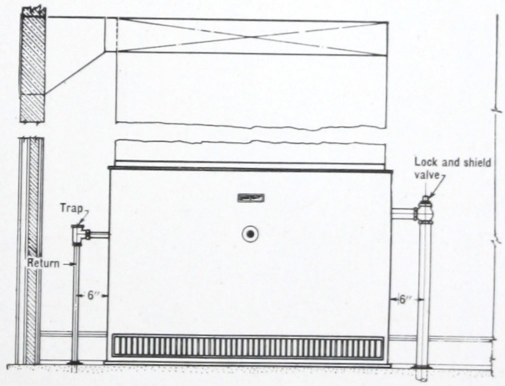
Where PeerVent is placed at ceiling



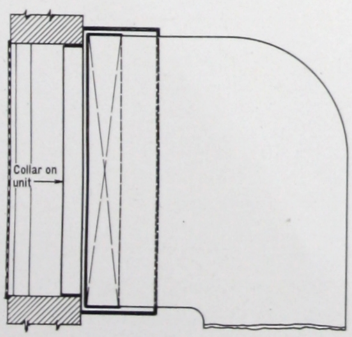
ELEVATION "AA"



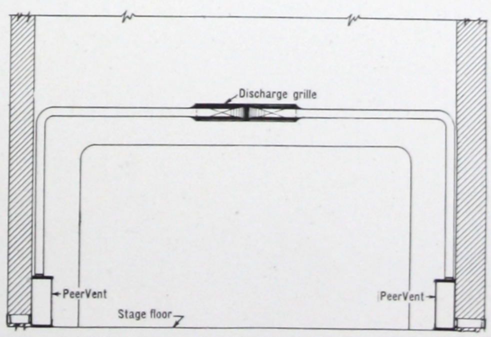
SECTIONAL ELEVATION



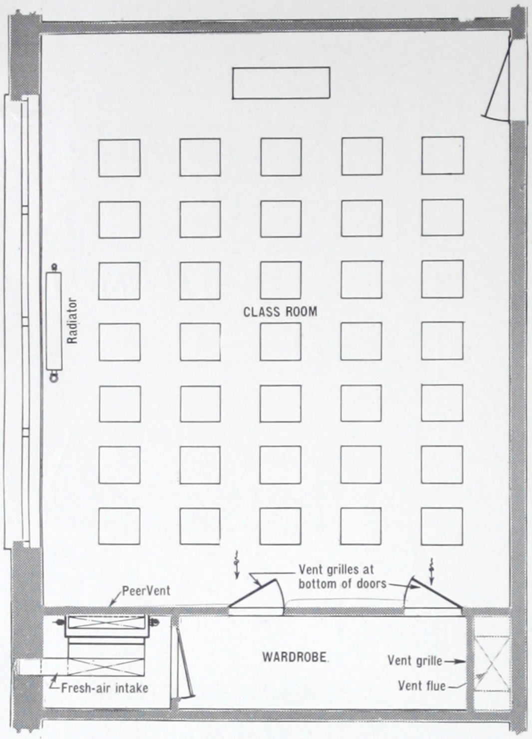
ELEVATION—**PeerVent Adaptation No. 8**

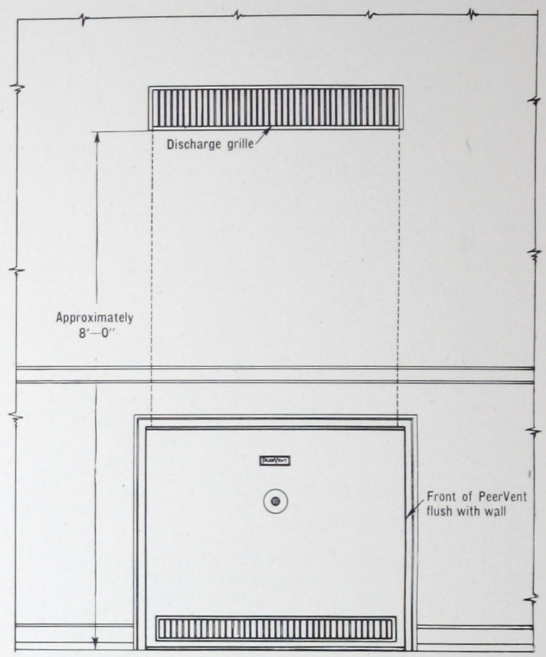


PLAN VIEW



Typical Layout of PeerVent Units Concealed in Back of Stage in Auditorium

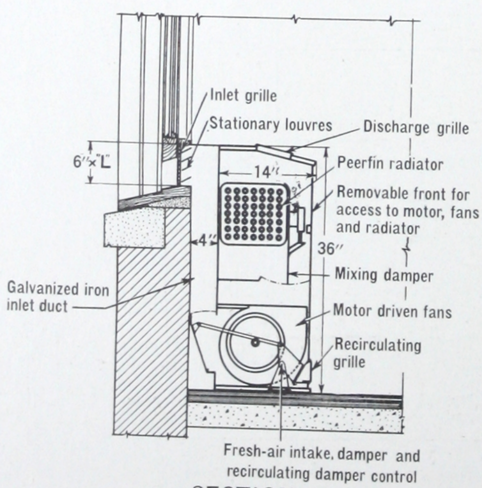




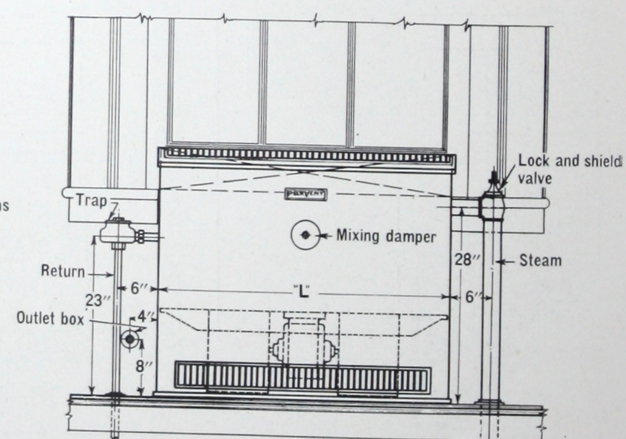
PLAN

ELEVATION

PeerVent Adaptation No. 9

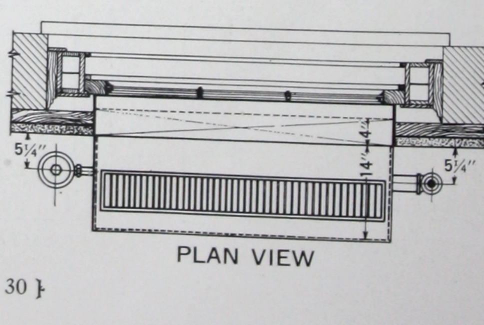


SECTION

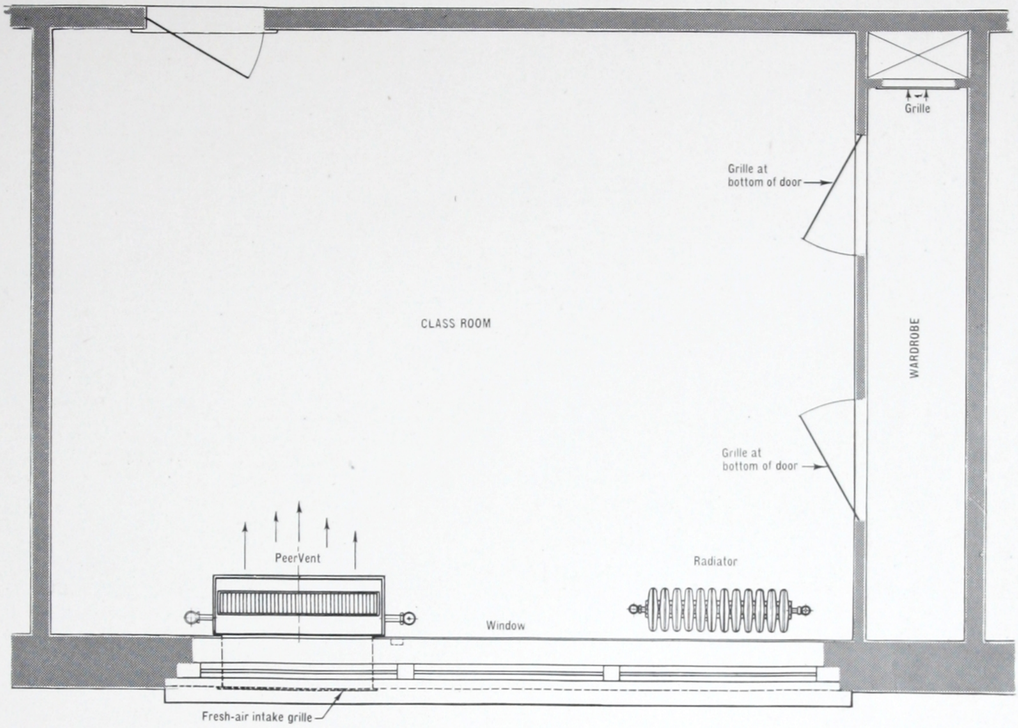


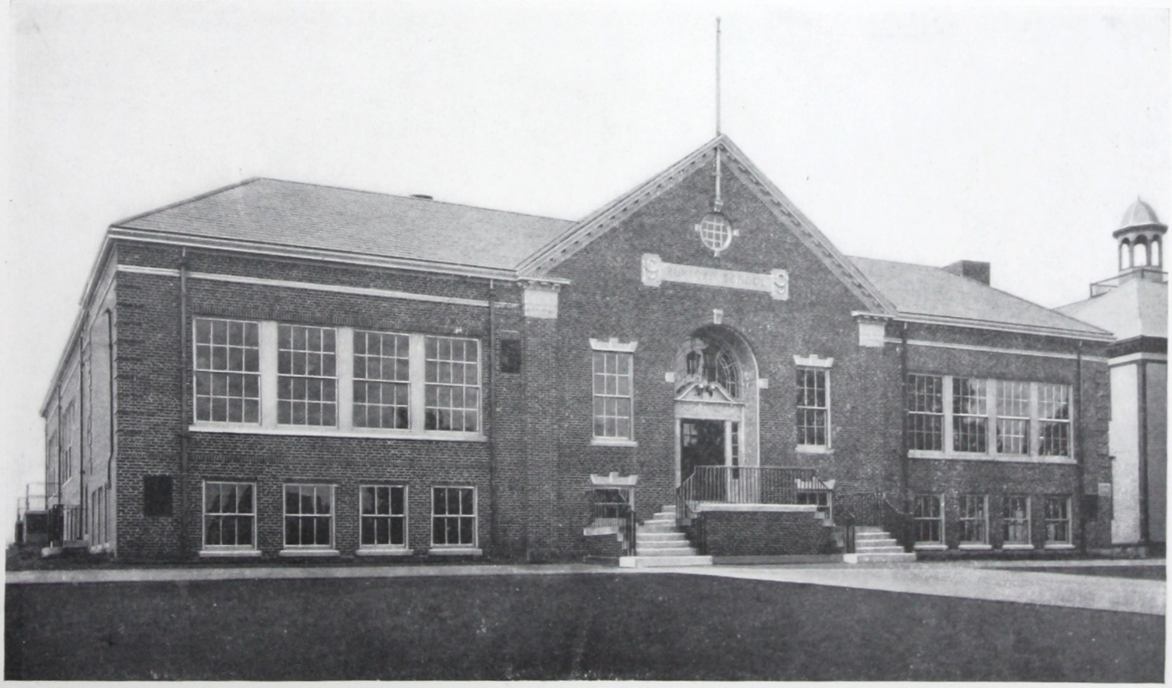
ELEVATION

PeerVent Adaptation No. 10



PLAN VIEW

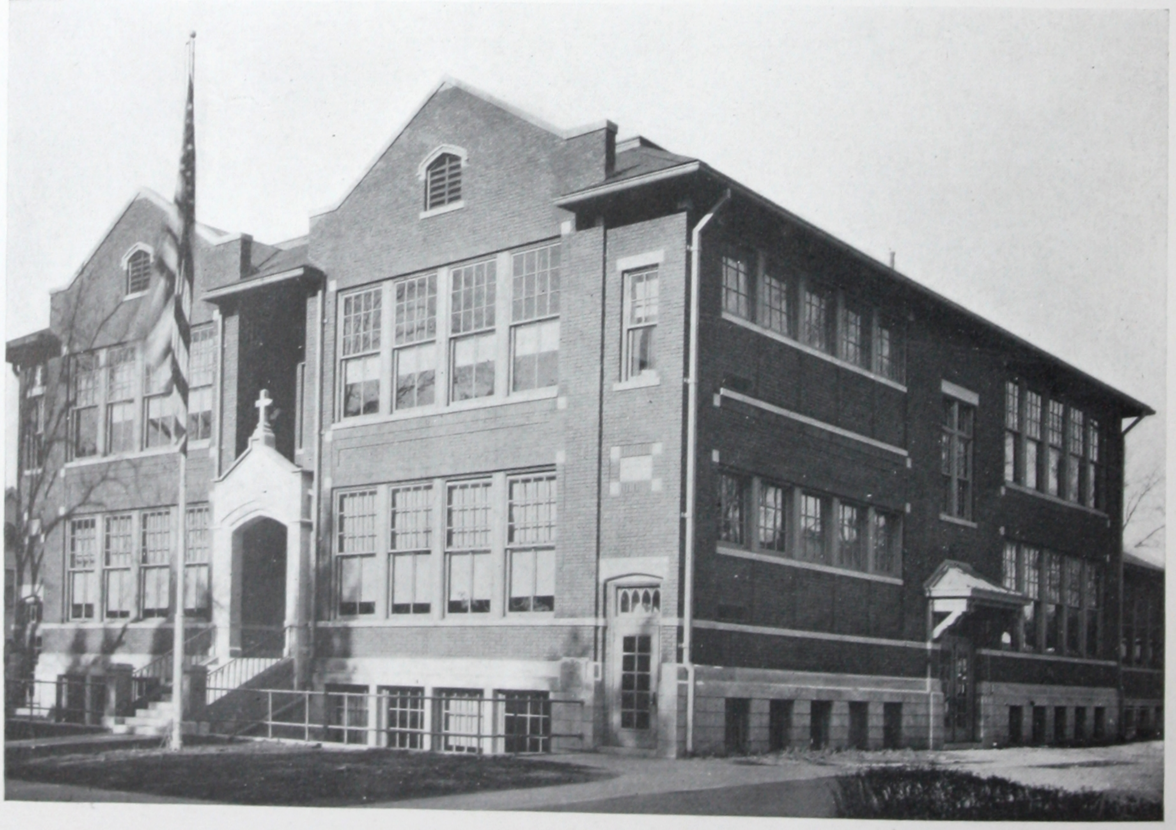




Architects: McLaughlin & Burr, Boston. *Engineers: Bolles & Dwyer, Boston.*

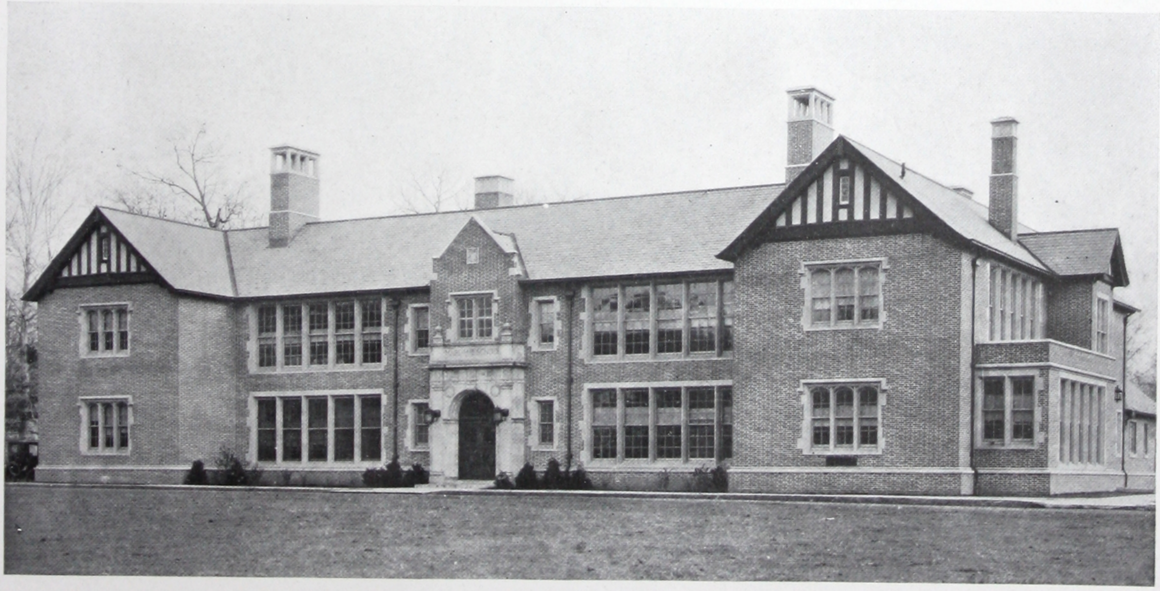
Rumford School, Woburn, Mass.

Architects: Wm. D. Johnson Company, Hartford, Conn.
Holcomb Street School, Hartford, Conn.



Architects: Whiton & McMahon, Hartford, Conn.
St. James' Parochial School, South Manchester, Conn.

Architects: Rasmussen & Wayland, New York. Contractors: Oak Ridge Company, New York.
Public School, Mountain Lakes, N. J.



Architects Guilbert & Betelle, Newark N. J. Engineers: Runyon & Carey, Newark N. J.
Marshall School, South Orange, N. J.

Architect: Wm. T. Marchant, Hartford, Conn.
James Talcot School, West Hartford, Conn.

Architects Maynicke & Franke, New York   Consulting Engineer: Werner Nygren, New York
Children's Building, New York City

B.t.u. (British Thermal Unit) Method of Computing Heat Losses

THERE is only one way to figure heat losses accurately, and that is by the B.t.u. method. This method is not as complicated as it may appear.

If a room is to be maintained at a certain temperature at all times, it is plain that the radiation for that room must be capable of equaling the total of heat losses in the coldest weather.

Heat losses are expressed in B.t.u. (British Thermal Units). These losses are determined by totaling the transmission through exposed walls and glass surfaces, plus the loss due to air changes for ventilation (see following tables), based on the number of B.t.u. required per hour per degree difference between outside and inside temperatures.

To obtain the B.t.u. loss per square foot of wall or glass surface, find in the tables the type and thickness of material used, and multiply the factor or coefficient given, which is for 1 degree temperature difference, by the number of degrees difference between the desired inside temperature and the coldest outside temperature likely to be encountered.

To the losses thus obtained must be added the losses caused by air changes provided for ventilation.

To raise the temperature of one cubic foot of air 1 degree requires .02056 B.t.u. Thus the number of cubic feet in the room, multiplied by the number of air changes per hour, multiplied by .02056, gives the heat loss for one degree difference between inside and outside temperatures.

It is essential also to consider the exposure of the room to be heated. Rooms with a north or west exposure usually require 10% additional radiation. Rooms which are heated intermittently will require up to 30% additional radiation as compared with constantly-heated rooms.

By adding the losses through walls and glass, and the losses due to air changes, you have the total B.t.u. loss for the room figured. The total B.t.u. calculated is the amount of heat units that must be supplied per hour to maintain the desired room temperature.

In order to provide for B.t.u. losses, it is necessary to determine not only the coldest outside temperature likely to be met but also the desirable inside temperature for each particular type of room. As to the former, knowledge of local climatic conditions is essential. As to the latter, opinions differ on desirable inside temperatures, but the following figures may be taken as near enough to average requirements to meet all practical purposes:

Hospitals

Wards	75° F.
Private Rooms	80° F.
Operating Room	98° F.
Sun Rooms	70° F.
Reception Rooms	70° F.
Dressing Rooms	80° F.
Offices	70° F.
Bath Rooms	80° F.

Schools and Churches

Class Rooms	70° F.
Library	70° F.
Wardrobe	60° F.
Manual Training	65° F.
Laboratories	68° F.
Offices	70° F.
Auditorium	65° F.
Gymnasium	55° F.
Dressing Rooms	80° F.
Swimming Pool Room	75° F.
Toilets	65° F.
Stair Wells	60° F.
Vestibules	65° F.
Corridors	60° F.
Kitchens	60° F.
Dining Rooms	65° F.

How to Use the Tables

Multiply the number of square feet of wall surface by the factor (for 1 degree difference in temperature) given in the tables for the particular type of wall and material being used; then multiply the result by the number of degrees difference between desired inside temperature and probable coldest outside temperature. This gives you the total B.t.u. losses per hour through wall surface.

Add ten per cent for northern exposure or for unusual exposure due to wind.

Add ten per cent for a room that is heated only in daytime; 20 per cent if badly exposed and heated only in daytime.

Add thirty per cent if building is heated intermittently.

It is usually considered desirable to figure double-thick glass same as single, as in practice the double glass is often omitted in construction or broken in service and substituted with single-thick glass. Therefore, by taking the number of square feet of glass surface and multiplying by

the 1° factor for single glass and then by the temperature difference, you have the total B.t.u. per hour for glass.

To the total B.t.u. losses thus obtained must be added the losses due to air changes provided for ventilation. If a PeerVent Unit is to be used, its output in cubic feet of air per hour multiplied by .02056 gives the heat loss for one degree temperature rise. Multiply this figure by the number of degrees difference between desired inside temperature and coldest outside temperature.

Now add the B.t.u. losses due to wall surface, plus the losses for glass surface, plus the losses due to air changes, and you have the total B.t.u. required per hour to be provided by a PeerVent Unit and direct radiation.

The total B.t.u. per hour delivered by any PeerVent Unit can be determined by consulting the table on page 22.

Tables showing the various sizes of standard cast iron radiators, which will transmit approximately 250 B.t.u. per square foot per hour, and giving the number of square feet of heating surface, will be found on page 40.

Direct radiators are used only as an auxiliary in split systems including a heating and ventilating unit of the proper C.F.M. capacity. The unit should operate all of the time during which the building is being heated, and the direct radiation should be used only intermittently to compensate for any extreme condition which would affect the B.t.u. delivery of the unit, and then only for a period sufficient to take care of this temporary condition.

B.t.u. Losses

per Square Foot per Hour per Degree Difference in Temperature through Various Materials and Types of Exposed Building Construction

Kind of Material and Construction	Thickness of Material	B.t.u. Transmitted per sq. ft. of Surface — Difference in Temperature 1°	50°	55°	60°	65°	70°	75°	80°
Brick—Not Furred or Plastered	4″	.59	30	32	35	38	41	44	47
	8½″	.42	21	23	25	27	29	32	34
	13″	.32	16	18	19	21	22	24	26
	17½″	.26	13	14	16	17	18	20	21
	22″	.22	11	12	13	14	15	17	18
	26½″	.19	10	10	11	12	13	14	15
	31″	.16	8	9	10	10	11	12	13
Brick—Plastered One Side	4″	.56	28	31	34	36	39	42	45
	8½″	.40	20	22	24	26	28	30	32
	13″	.30	15	17	18	20	21	23	24
	17½″	.24	12	13	14	16	17	18	19
	22″	.20	10	11	12	13	14	15	16
	26½″	.18	9	10	11	12	13	14	14
	31″	.15	8	8	9	10	11	11	12
Brick—Air Space and Plaster One Side	8½″	.26	13	14	16	17	18	20	21
	13″	.22	11	12	13	14	15	17	18
	17½″	.19	10	10	11	12	13	14	15
	22″	.16	8	9	10	10	11	12	13
	26½″	.14	7	8	8	9	10	11	11
	31″	.12	6	7	7	8	8	9	10
Brick—Furred and Plastered	4″	.34	17	19	20	22	24	26	27
	8½″	.27	14	15	16	18	19	20	22
	13″	.22	11	12	13	14	15	17	18
	17½″	.19	10	10	11	12	13	14	15
	22″	.16	8	9	10	10	11	12	13
	26½″	.14	7	8	8	9	10	11	11
	31″	.12	6	7	7	8	8	9	10

Kind of Material and Construction	Thickness of Material	B.t.u. Transmitted per sq. ft. of Surface — Difference in Temperature 1°	50°	55°	60°	65°	70°	75°	80°
Stone and Plaster	12″	.48	24	26	29	31	34	36	38
	16″	.43	22	24	26	28	30	32	34
	20″	.38	19	21	23	25	27	29	30
	24″	.35	18	19	21	23	25	26	28
	28″	.31	16	17	19	20	22	23	25
	32″	.28	14	15	17	18	20	21	22
	36″	.25	13	14	15	16	18	19	20
Concrete and Plaster	8″	.50	25	28	30	33	35	38	40
	12″	.44	22	24	26	29	31	33	35
	16″	.37	19	20	22	24	26	28	30
	20″	.33	17	18	20	21	23	25	26
	24″	.31	16	17	19	20	22	23	25
Brick Facing on Concrete and Plaster	4″	.50	25	28	30	33	35	38	40
	8″	.43	22	24	26	28	30	32	34
	12″	.39	20	21	23	25	27	29	31
	16″	.35	18	19	21	23	25	26	28
	20″	.31	16	17	19	20	22	23	25
	24″	.27	14	15	16	18	19	20	22
Brick Facing on Hollow Tile and Plaster	4″	.23	12	13	14	15	16	17	18
	6″	.21	11	12	13	14	15	16	17
	8″	.18	9	10	11	12	13	14	14
	10″	.16	8	9	10	10	11	12	13
	12″	.14	7	8	8	9	10	11	11
Terra Cotta Facing on Brick and Plaster	4″TC– 4″B	.24	12	13	14	16	17	18	19
	4″TC– 8″B	.20	10	11	12	13	14	15	16
	8″TC– 8″B	.17	9	9	10	11	12	13	14
	8″TC–12″B	.14	7	8	8	9	10	11	11
	12″TC– 8″B	.10	5	6	6	7	7	8	8

B.t.u. Losses

per Square Foot per Hour per Degree Difference in Temperature through Various Materials and Types of Exposed Building Construction

Kind of Material and Construction	B.t.u. Transmitted per sq. ft. of Surface — Difference in Temperature 1°	50°	55°	60°	65°	70°	75°	80°
Ordinary Overlapping Clapboard Siding	.45	23	25	27	29	31	34	36
Same with Paper Lining	.32	16	18	19	21	22	24	26
Same with Sheathing	.29	15	16	17	19	20	22	23
Same with Sheathing and Paper	.24	12	13	14	16	17	18	19
Brick Veneer and Sheathing	.21	11	12	13	14	15	16	17
Stucco, Wire Lath, Air Space and Sheathing	.23	12	13	14	15	16	17	18

Kind of Material and Construction	B.t.u. Transmitted per Sq. Ft. of Surface — Difference in Temperature 1°	50°	55°	60°	65°	70°	75°	80°
PORTABLE WALLS								
Cor'gtd Iron on ½″ Board	.48	24	26	29	31	34	36	38
Cor'gtd Iron on 1″ Board	.38	19	21	23	25	27	29	30
Cor'gtd Iron on 1½″ Board	.32	16	18	19	21	22	24	26
Cor'gtd Iron on 2″ Board	.27	14	15	16	18	19	20	22
Cor'gtd Iron on 2½″ Board	.24	12	13	14	16	17	18	19
Cor'gtd Iron Only	1.2	60	66	72	78	84	90	96
GLASS								
Plate	.74	37	41	44	48	52	56	59
Single	1.05	53	52	63	68	74	79	84
Double	.49	25	27	29	32	34	37	39
Single Skylight	1.13	57	62	68	73	79	85	90
Double Skylight	.55	28	30	33	36	39	41	44
Steel Sash Wire Mesh	1.22	61	67	73	79	85	92	98
Monitor	1.31	66	72	79	85	92	98	105
Side Walk Prism	1.45	73	80	87	94	102	109	116

B.t.u. Required for Heating Air

Multiply the cubical contents of the room by the factor given in this table. The result is the B.t.u. loss which must be supplied by the radiators

External Temperature Deg. Fahr.	Temperature of Air in Room 40	50	60	70	80	90	100	110	120	130
—40	1.802	2.027	2.252	2.479	2.703	2.928	3.154	3.379	3.604	3.829
—30	1.540	1.760	1.980	2.200	2.420	2.640	2.860	3.080	3.300	3.520
—20	1.290	1.505	1.720	1.935	2.150	2.365	2.580	2.795	3.010	3.225
—10	1.051	1.262	1.473	1.684	1.892	2.102	2.311	2.522	2.732	2.943
0	.822	1.028	1.234	1.439	1.645	1.851	2.056	2.262	2.467	2.673
10	.604	.805	1.007	1.208	1.409	1.611	1.812	2.013	2.215	2.416
20	.393	.590	.787	.984	1.181	1.378	1.575	1.771	1.968	2.165
30	.192	.385	.578	.770	.963	1.155	1.345	1.540	1.735	1.925
40	....	.188	.376	.564	.752	.940	1.128	1.316	1.504	1.692
50	....	....	.184	.367	.551	.735	.918	1.102	1.286	1.470
60	....	....	....	.179	.359	.538	.718	.897	1.077	1.256
70	....	....	....	....	.175	.350	.525	.700	.875	1.049

Measurements of Rooms

Square Feet of Wall Surface

Running Feet of Wall	Ceiling Heights—Feet 8	8½	9	9½	10	10½	11	11½	12	13	14	15
6	48	51	54	57	60	63	66	69	72	78	84	90
6½	52	55	59	62	65	68	72	75	78	85	91	98
7	56	60	63	67	70	74	77	81	84	91	98	105
7½	60	64	68	72	75	79	83	86	90	98	105	113
8	64	68	72	76	80	84	88	92	96	104	112	120
8½	68	72	77	81	85	89	94	98	102	111	119	128
9	72	76	81	86	90	94	99	104	108	117	126	135
9½	76	81	86	90	95	100	105	109	114	124	133	143
10	80	85	90	95	100	105	110	115	120	130	140	150
10½	84	89	95	100	105	110	116	121	126	137	147	158
11	88	94	99	105	110	116	121	127	132	143	154	165
11½	92	98	104	109	115	121	127	132	138	150	161	173
12	96	102	108	114	120	126	132	138	144	156	168	180
12½	100	106	113	119	125	131	138	144	150	163	175	188
13	104	111	117	123	130	137	143	150	156	169	182	195
13½	108	115	122	129	135	142	149	155	162	176	189	203
14	112	119	126	133	140	147	154	161	168	182	196	210
14½	116	123	131	138	145	152	160	167	174	189	203	218
15	120	128	135	143	150	158	165	173	180	195	210	225
15½	124	132	140	147	155	163	171	178	186	202	217	233
16	128	136	144	152	160	168	176	184	192	208	224	240
16½	132	140	149	157	165	173	182	190	198	215	231	248
17	136	145	153	162	170	179	187	196	204	221	238	255
17½	140	149	158	166	175	184	193	201	210	228	245	263
18	144	153	162	171	180	189	198	207	216	234	252	270
19	152	162	171	181	190	200	209	219	228	247	266	285
20	160	170	180	190	200	210	220	230	240	260	280	300
21	168	179	189	200	210	221	231	242	252	273	294	315
22	176	187	198	209	220	231	242	253	264	286	308	330
23	184	196	207	218	230	242	253	264	276	299	322	345
24	192	204	216	228	240	252	264	276	288	312	336	360
25	200	213	225	238	250	263	275	288	300	325	350	375
26	208	221	234	247	260	273	286	299	312	338	364	390
27	216	230	243	257	270	284	297	311	324	351	378	405
28	224	238	252	266	280	294	308	322	336	364	392	420
29	232	247	261	276	290	305	319	334	348	377	406	435
30	240	255	270	285	300	315	330	345	360	390	420	450
31	248	264	279	295	310	326	341	357	372	403	434	465
32	256	272	288	304	320	336	352	368	384	416	448	480

To simplify calculations, dimensions less than 3 inches have been omitted; that is, 9 inches should be extended to next even foot, and 3 inches over a foot should be dropped to nearest even foot. Where, for example, a room is 10′ 3″ by 13′ 9″ with an 9′ 10″ ceiling, such a room may be considered a 10—14—10 room.

Full Area of Two-Pane Windows

Giving the Total Area of Two-Pane Windows, Including the Sash

WIDTH GLASS INCHES	WIDTH OF OPENING	HEIGHT GLASS	18″	20″	22″	24″	26″	28″	30″	32″	34″	36″	38″	40″	42″	44″	46″	48″	50″	52″	54″
		HEIGHT OPENING	3′-6″	3′-10″	4′-2″	4′-6″	4′-10″	5′-2″	5′-6″	5′-10″	6′-2″	6′-6″	6′-10″	7′-2″	7′-6″	7′-10″	8′-2″	8′-6″	8′-10″	9′-2″	9′-6″
16	1′-8″	Standard Sizes of Two-Light Windows	5.8	6.4	7.0	7.5	8.0	8.6	9.2	9.7	10.3	10.8	11.4	11.9	12.5	13.0	13.6	14.2	14.7	15.2	15.8
18	1′-10″		6.4	7.0	7.6	8.2	8.9	9.5	10.1	10.7	11.3	11.9	12.5	13.1	13.7	14.3	15.0	15.6	16.2	16.8	17.4
20	2′-0		7.0	7.7	8.3	9.0	9.7	10.3	11.0	11.7	12.3	13.0	13.6	14.3	15.0	15.6	16.3	17.0	17.7	18.3	19.0
22	2′-2″		7.6	8.3	9.0	9.7	10.5	11.2	11.9	12.6	13.4	14.0	14.7	15.5	16.2	17.0	17.7	18.4	19.2	19.8	20.6
24	2′-4″		8.2	8.9	9.7	10.5	11.3	12.0	12.8	13.6	14.4	15.1	15.9	16.7	17.4	18.2	19.0	19.8	20.6	21.4	22.2
26	2′-6″		8.7	9.6	10.4	11.2	12.0	12.8	13.7	14.6	15.4	16.2	17.1	17.9	18.7	19.5	20.4	21.2	22.0	23.0	23.8
28	2′-8″		9.3	10.2	11.1	12.0	12.9	13.8	14.7	15.5	16.4	17.3	18.2	19.1	20.0	20.8	21.8	22.6	23.5	24.4	25.3
30	2′-10″		10.0	10.8	11.8	12.8	13.7	14.6	15.6	16.5	17.5	18.4	19.3	20.3	21.2	22.2	23.2	24.0	25.0	26.0	27.0
32	3′-0″		10.5	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	20.5	21.5	22.5	23.5	24.5	25.5	26.5	27.5	28.5
34	3′-2″		11.0	12.1	13.2	14.3	15.3	16.4	17.4	18.5	19.5	20.6	21.6	22.6	23.7	24.8	25.8	27.0	28.0	29.0	30.0
36	3′-4″		11.7	12.8	13.9	15.0	16.1	17.2	18.3	19.5	20.5	21.6	22.8	23.8	25.0	26.1	27.2	28.3	29.4	30.5	31.7
38	3′-6″		12.2	13.4	14.6	15.8	16.9	18.0	19.2	20.4	21.6	22.7	24.0	25.0	26.2	27.4	28.6	29.8	31.0	32.1	33.2
40	3′-8″		12.8	14.0	15.3	16.5	17.7	18.9	20.1	21.4	22.6	23.8	25.1	26.2	27.4	28.7	30.0	31.2	32.4	33.6	34.9
42	3′-10″		13.4	14.7	16.0	17.3	18.5	19.8	21.0	22.4	23.6	24.9	26.2	27.4	28.6	30.0	31.3	32.6	33.8	35.0	36.4
44	4′-0″		14.0	15.3	16.7	18.0	19.3	20.7	22.0	23.4	24.6	26.0	27.3	28.6	30.0	31.3	32.6	34.0	35.3	36.5	38.0
46	4′-2″		14.6	16.0	17.4	18.8	20.1	21.5	23.0	24.4	25.6	27.1	28.4	29.8	31.2	32.6	34.0	35.5	36.8	38.2	39.6
48	4′-4″		15.2	16.6	18.0	19.5	20.9	22.4	23.8	25.3	26.7	28.1	29.5	31.0	32.4	34.0	35.4	36.8	38.3	39.6	41.0
50	4′-6″		15.7	17.2	18.7	20.3	21.8	23.2	24.8	26.2	27.7	29.2	30.7	32.2	33.7	35.2	36.7	38.2	39.7	41.2	42.6
52	4′-8″		16.3	17.9	19.4	21.0	22.5	24.0	25.6	27.2	28.7	30.3	31.8	33.4	35.0	36.5	38.0	39.6	41.2	42.7	44.2
54	4′-10″		16.9	18.5	20.1	21.8	23.4	25.0	26.6	28.2	29.8	31.4	32.9	34.6	36.2	37.8	39.5	41.0	42.7	44.3	46.0
56	5′-0″		17.5	19.3	20.8	22.5	24.2	25.8	27.5	29.0	30.8	32.5	34.0	35.8	37.5	39.8	40.8	42.5	44.2	46.0	47.5

Heating Surface in Square Feet
Standard Cast Iron Direct Radiation

		SINGLE COLUMN					TWO COLUMN					THREE COLUMN					FOUR COLUMN					Window			
No. of Sections	Length 2½" per Section	3 sq. ft. per Section	2½ sq. ft. per Section	2 sq. ft. per Section	1⅔ sq. ft. per Section	1½ sq. ft. per Section	4 sq. ft. per Section	3⅓ sq. ft. per Section	2⅔ sq. ft. per Section	2⅓ sq. ft. per Section	2 sq. ft. per Section	5 sq. ft. per Section	4½ sq. ft. per Section	3¾ sq. ft. per Section	3 sq. ft. per Section	2¼ sq. ft. per Section	8 sq. ft. per Section	6½ sq. ft. per Section	5 sq. ft. per Section	4 sq. ft. per Section	3 sq. ft. per Section	4¾ sq. ft. per Section	4 sq. ft. per Section	Length 2½" per Section	No. of Sections.
		38"	32"	26"	23"	20"	38"	32"	26"	23"	20"	38"	32"	26"	22"	18"	38"	32"	26"	22"	18"	28"	24"		
2	5	6	5	4	3⅓	3	8	6⅔	5⅓	4⅔	4	10	9	7½	6	4½	16	13	10	8	6	9½	8	5	2
3	7½	9	7½	6	5	4½	12	10	8	7	6	15	13½	11¼	9	6¾	24	19½	15	12	9	14¼	12	7½	3
4	10	12	10	8	6⅔	6	16	13⅓	10⅔	9⅓	8	20	18	15	12	9	32	26	20	16	12	19	16	10	4
5	12½	15	12½	10	8⅓	7½	20	16⅔	13⅓	11⅔	10	25	22½	18¾	15	11¼	40	32½	25	20	15	23¾	20	12½	5
6	15	18	15	12	10	9	24	20	16	14	12	30	27	22½	18	13½	48	39	30	24	18	28½	24	15	6
7	17½	21	17½	14	11⅔	10½	28	23⅓	18⅔	16⅓	14	35	31½	26¼	21	15¾	56	45½	35	28	21	33¼	28	17½	7
8	20	24	20	16	13⅓	12	32	26⅔	21⅓	18⅔	16	40	36	30	24	18	64	52	40	32	24	38	32	20	8
9	22½	27	22½	18	15	13½	36	30	24	21	18	45	40½	33¾	27	20¼	72	58½	45	36	27	42¾	36	22½	9
10	25	30	25	20	16⅔	15	40	33⅓	26⅔	23⅓	20	50	45	37½	30	22½	80	65	50	40	30	47½	40	25	10
11	27½	33	27½	22	18⅓	16½	44	36⅔	29⅓	25⅔	22	55	49½	41¼	33	24¾	88	71½	55	44	33	52¼	44	27½	11
12	30	36	30	24	20	18	48	40	32	28	24	60	54	45	36	27	96	78	60	48	36	57	48	30	12
13	32½	39	32½	26	21⅔	19½	52	43⅓	34⅔	30⅓	26	65	58½	48¾	39	29¼	104	84½	65	52	39	61¾	52	32½	13
14	35	42	35	28	23⅓	21	56	46⅔	37⅓	32⅔	28	70	63	52½	42	31½	112	91	70	56	42	66½	56	35	14
15	37½	45	37½	30	25	22½	60	50	40	35	30	75	67½	56¼	45	33¾	120	97½	75	60	45	71¼	60	37½	15
16	40	48	40	32	26⅔	24	64	53⅓	42⅔	37⅓	32	80	72	60	48	36	128	104	80	64	48	76	64	40	16
17	42½	51	42½	34	28⅓	25½	68	56⅔	45⅓	39⅔	34	85	76½	63¾	51	38¼	136	110½	85	68	51	80¾	68	42½	17
18	45	54	45	36	30	27	72	60	48	42	36	90	81	67½	54	40½	144	117	90	72	54	85½	72	45	18
19	47½	57	47½	38	31⅔	28½	76	63⅓	50⅔	44⅓	38	95	85½	71¼	57	42¾	152	123½	95	76	57	90¼	76	47½	19
20	50	60	50	40	33⅓	30	80	66⅔	53⅓	46⅔	40	100	90	75	60	45	160	130	100	80	60	95	80	50	20
21	52½	63	52½	42	35	31½	84	70	56	49	42	105	94½	78¾	63	47¼	168	136½	105	84	63	...	...	...	21
22	55	66	55	44	36⅔	33	88	73⅓	58⅔	51⅓	44	110	99	82½	66	49½	176	143	110	88	66	...	...	...	22
23	57½	69	57½	46	38⅓	34½	92	76⅔	61⅓	53⅔	46	115	103½	86¼	69	51¾	184	149½	115	92	69	...	...	...	23
24	60	72	60	48	40	36	96	80	64	56	48	120	108	90	72	54	192	156	120	96	72	...	...	...	24
25	62½	75	62½	50	41⅔	37½	100	83⅓	66⅔	58⅓	50	125	112½	93¾	75	56¼	200	162½	125	100	75	...	...	...	25
26	65	78	65	52	43⅓	39	104	86⅔	69⅓	60⅔	52	130	117	97½	78	58½	208	169	130	104	78	...	...	...	26

Square Feet of Surface per Lineal Foot of Pipe on All Lengths Over 1 Foot

Fractions Less than Tenths are Added To or Dropped

Length of Pipe	SIZE OF PIPE											
1	¾ .275	1 .346	1¼ .434	1½ .494	2 .622	2½ .753	3 .916	4 1.175	5 1.455	6 1.739	7 1.996	8 2.257
2	.5	.7	.9	1.	1.2	1.5	1.8	2.4	2.9	3.5	4.	4.5
3	.8	1.	1.3	1.5	1.9	2.3	2.7	3.5	4.4	5.2	6.	6.8
4	1.1	1.4	1.7	2.	2.5	3.	3.6	4.7	5.8	7.	8.	9.
5	1.4	1.7	2.2	2.4	3.1	3.8	4.6	5.8	7.3	7.7	10.	11.3
6	1.6	2.1	2.6	2.9	3.7	4.5	5.5	7.	8.7	10.5	12.	13.5
7	1.9	2.4	3.	3.4	4.4	5.3	6.4	8.2	10.2	12.1	14.	15.8
8	2.2	2.8	3.5	3.9	5.	6.	7.3	9.4	11.6	13.9	16.	18.
9	2.5	3.1	3.9	4.4	5.6	6.8	8.2	10.6	13.1	15.7	18.	20.3
10	2.7	3.5	4.3	4.9	6.2	7.5	9.1	11.8	14.6	17.4	20.	22.6
11	3.	3.8	4.8	5.4	6.8	8.3	10.	12.9	16.	19.1	22.	24.9
12	3.3	4.1	5.2	5.9	7.5	9.	11.	14.1	17.4	20.9	24.	27.1
13	3.6	4.5	5.6	6.4	8.1	9.8	11.9	15.3	18.9	22.6	26.	29.4
14	3.8	4.8	6.1	6.9	8.7	10.5	12.8	16.5	20.3	24.3	28.	31.6
15	4.1	5.2	6.5	7.4	9.3	11.3	13.7	17.6	21.8	26.1	30.	33.9
16	4.4	5.5	6.9	7.9	10.	12.	14.6	18.8	23.2	27.8	32.	36.1
17	4.7	5.9	7.4	8.4	10.6	12.8	15.5	20.	24.7	29.5	34.	38.4
18	5.	6.2	7.8	8.9	11.2	13.5	16.5	21.2	26.2	31.3	36.	40.6
19	5.2	6.6	8.3	9.4	11.8	14.3	17.4	22.3	27.6	33.1	38.	42.9
20	5.5	6.9	8.7	9.9	12.5	15.	18.3	23.5	29.1	34.8	40.	45.2
21	5.8	7.3	9.1	10.4	13.	15.8	19.2	24.7	30.5	36.5	42.	47.4
22	6.	7.6	9.6	10.9	13.7	16.5	20.2	25.9	32.	38.3	44.	49.7
23	6.3	8.	10.	11.3	14.3	17.3	21.1	27.	33.5	40.	46.	52.
24	6.6	8.3	10.4	11.9	14.9	18.	22.	28.2	34.9	41.7	48.	54.2
25	6.9	8.6	10.9	12.3	15.6	18.8	22.9	29.3	36.3	43.5	50.	56.4
26	7.1	9.	11.3	12.8	16.2	19.5	23.8	30.5	37.8	45.2	52.	58.6
27	7.4	9.4	11.7	13.3	16.8	20.3	24.7	31.7	39.3	47.	54.	61.
28	7.7	9.7	12.2	13.8	17.4	21.	25.6	32.9	40.7	48.7	56.	63.2
29	8.	10.	12.6	14.3	18.	21.8	26.6	34.1	42.2	50.4	58.	65.5
30	8.3	10.4	13.	14.8	18.7	22.5	27.5	35.3	43.6	52.1	60.	67.7
31	8.5	10.7	13.5	15.3	19.3	23.3	28.4	36.4	45.1	53.9	62.	70.
32	8.8	11.1	13.9	15.8	19.9	24.1	29.3	37.6	46.5	55.6	64.	72.2
33	9.1	11.4	14.3	16.3	20.5	24.8	30.2	38.8	48.	57.4	66.	74.4
34	9.4	11.7	14.7	16.8	21.2	25.6	31.1	40.	49.5	59.1	68.	76.7
35	9.6	12.1	15.2	17.3	21.8	26.3	32.	41.1	50.9	60.8	70.	79.
36	9.9	12.5	15.6	17.8	22.4	27.	33.	42.3	52.4	62.6	72.	81.3
37	10.2	12.8	16.1	18.3	23.	27.8	33.9	43.5	53.8	64.3	74.	83.5
38	10.5	13.2	16.5	18.8	23.7	28.5	34.8	44.6	55.2	66.	76.	85.8
39	10.7	13.5	16.9	19.3	24.3	29.3	35.7	45.8	56.7	67.8	78.	88.
40	11.	13.8	17.4	19.8	24.9	30.1	36.6	47.	58.2	69.5	80.	90.2
41	11.3	14.2	17.8	20.3	25.5	30.8	37.6	48.2	59.6	71.3	82.	92.5
42	11.5	14.5	18.2	20.8	26.1	31.6	38.5	49.4	61.1	73.	84.	94.8
43	11.8	14.9	18.7	21.3	26.8	32.3	39.4	50.6	62.5	74.8	86.	97.
44	12.1	15.2	19.1	21.8	27.4	33.1	40.3	51.7	64.	76.5	88.	99.3
45	12.4	15.6	19.5	22.2	28.	33.8	41.2	52.9	65.5	78.2	90.	101.6
46	12.7	15.9	20.	22.7	28.6	34.6	42.2	54.	67.	80.	92.	103.8
47	12.9	16.3	20.4	23.2	29.2	35.3	43.	55.2	68.4	81.7	94.	106.
48	13.2	16.6	20.8	23.7	29.9	36.1	43.9	56.4	69.8	83.5	96.	108.4
49	13.5	17.	21.3	24.2	30.5	36.8	44.8	57.6	71.2	85.1	98.	110.5
50	13.8	17.3	21.7	24.7	31.1	37.6	45.8	58.7	72.7	87.	100.	112.8

Standard Dimensions of Wrought Iron Welded Steam, Gas and Water Pipe

Diameter: Nominal Internal	Diameter: Actual External	Diameter: Actual Internal	Thickness	Circumference: External	Circumference: Internal	Transverse Areas: External	Transverse Areas: Internal	Transverse Areas: Metal	Length of Pipe per Sq. Ft. of External Surface	Length of Pipe per Sq. Ft. of Internal Surface	Length of Pipe Containing One Cu. Ft.	Nominal Weight per Foot	No. of Threads per Inch of Screw	Tap Drill
Inches	Inches	Inches	Inches	Inches	Inches	Sq. In.	Sq. In.	Sq. In.	Feet	Feet	Feet	Lbs.		
1/8	0.405	0.27	0.068	1.272	0.848	0.129	0.0573	0.0717	9.44	14.15	2513.	0.241	27	11/22
1/4	0.54	0.364	0.088	1.696	1.144	0.229	0.1041	0.1249	7.075	10.49	1383.3	0.42	18	1/16
3/8	0.675	0.494	0.091	2.121	1.552	0.358	0.1917	0.1663	5.657	7.73	751.2	0.559	18	9/16
1/2	0.84	0.623	0.109	2.639	1.957	0.554	0.3048	0.2492	4.547	6.13	472.4	0.837	14	11/16
3/4	1.05	0.824	0.113	3.299	2.589	0.866	0.5333	0.3327	3.637	4.635	270.	1.115	14	15/16
1	1.315	1.048	0.134	4.131	3.292	1.358	0.8626	0.4954	2.904	3.645	166.9	1.668	11 1/2	1 3/16
1 1/4	1.66	1.38	0.14	5.215	4.335	2.164	1.496	0.668	2.301	2.768	97.25	2.244	11 1/2	1 1/2
1 1/2	1.9	1.611	0.145	5.969	5.061	2.835	2.038	0.797	2.01	2.371	70.66	2.678	11 1/2	1 3/4
2	2.375	2.067	0.154	7.461	6.494	4.43	3.356	1.074	1.608	1.848	42.91	3.609	11 1/2	2 1/4
2 1/2	2.875	2.468	0.204	9.032	7.753	6.492	4.784	1.708	1.328	1.547	30.1	5.739	8	2 11/16
3	3.5	3.067	0.217	10.996	9.636	9.621	7.388	2.243	1.091	1.245	19.5	7.536	8	3 5/16
3 1/2	4.	3.548	0.226	12.566	11.146	12.566	9.887	2.679	0.955	1.077	14.57	9.001	8	3 13/16
4	4.5	4.026	0.237	14.137	12.648	15.904	12.73	3.174	0.849	0.949	11.31	10.665	8	4 5/16
4 1/2	5.	4.508	0.246	15.708	14.162	19.635	15.961	3.674	0.764	0.848	9.02	12.34	8	....
5	5.563	5.045	0.259	17.477	15.849	24.306	19.99	4.316	0.687	0.757	7.2	14.502	8	....
6	6.625	6.065	0.28	20.813	19.054	34.472	28.888	5.584	0.577	0.63	4.98	18.762	8	....
7	7.625	7.023	0.301	23.955	22.063	45.664	38.738	6.926	0.501	0.544	3.72	23.271	8	......
8	8.625	7.982	0.322	27.096	25.076	58.426	50.04	8.386	0.443	0.478	2.88	28.177	8	......
9	9.625	8.937	0.344	30.238	28.076	72.76	62.73	10.03	0.397	0.427	2.29	33.701	8	....
10	10.75	10.019	0.366	33.772	31.477	90.763	78.839	11.924	0.355	0.382	1.82	40.065	8	....

Table Showing Expansion of Wrought Iron Pipe

Initial Temperature	Increase in Length per 100 Feet when Heated to 160°	180°	200°	212°	228°	240°	250°	259°	267°	274°
Zero—inches......	1.28	1.44	1.60	1.69	1.82	1.92	2.00	2.07	2.13	2.20
32° inches......	1.02	1.18	1.34	1.43	1.56	1.66	1.74	1.81	1.87	1.94
64° inches......	0.77	0.93	1.09	1.18	1.31	1.41	1.49	1.56	1.61	1.69
	HOT WATER			WATER BOILS	5 lb.	10 lb.	15 lb.	20 lb.	25 lb.	30 lb.

Wrought iron pipe expands, in inches per 100 ft., 4/5 of the increase in temperature of the steam or water it is subjected to, over the temperature at the time of installation, divided by 100.

Example.—Temperature when installed, 32°, 10 lb. pressure = 240°, difference 208°, 4/5 of which equals 1.66 in. expansion per 100 ft.

Capacities of Mains and Risers

As Applied to Vapor Systems of Steam Circulation

Length of supply and return piping in feet from source of supply to farthest radiator. Allowance for elbows and valves must be added to measured distance. Pipe capacities in square feet of direct cast iron radiation given for each length. Supply risers based on length of supply, Return riser ¾″ up to 200°, 1″ to 400°, 1¼″ to 800°.

Size of Supply, Inches	Size of Return, Inches	100	200	300	400	500	750	1000	1250	1500
1	1	87	64	50	44	38	30	27	25	20
1¼	1	161	114	94	81	71	59	51	45	42
1½	1	267	189	149	129	118	97	84	76	70
2	1¼	589	436	363	314	285	242	203	179	169
2½	1¼	1026	702	583	502	465	388	330	290	266
3	1½	1862	1308	1023	910	816	671	606	580	483
3½	1½	2662	1905	1524	1316	1212	968	871	740	702
4	2	3725	2630	2152	1848	1669	1383	1212	1066	992
4½	2	4993	3512	2866	2468	2230	1814	1598	1450	1330
5	2½	6620	4698	3845	3305	2992	2420	2152	1936	1766
6	3	10658	7527	6033	5304	4692	3896	3486	3100	2810
7	3½	15500	11150	9029	7713	6883	5616	4936	4550	4040
8	4	21783	15500	12433	10850	9680	7850	6583	6100	5813
9	4½	29066	21300	16466	14533	13083	10333	9100	8133	7550
10	5	38733	28100	22550	19366	17433	14116	12316	11150	10166
12	6	61900	43600	35542	30772	27533	22266	19116	17516	16266
14	7	82333	58133	45900	39700	35316	28550	24966	22750	20700
15	7	96806	68133	55166	47283	42083	36016	29516	26783	24683
16	8	115333	82325	67825	58583	52266	41733	36683	33100	30033

Capacities of Mains and Risers

As Applied to the Vacuum System of Steam Circulation

ONE QUARTER POUND PRESSURE LOSS

Length of supply and return piping in feet from source of supply to farthest radiator. Allowance for elbows and valves must be added to measured distance. Pipe capacities in square feet of direct cast iron radiation are given for each length. Supply risers are based on length of supply, Return riser, ¾″ up to 800 sq. ft.; 1″ to 1500 sq. ft.; 1¼″ to 2400 sq.ft.

Size of Supply, Inches	200	300	400	500	750	1000	1250	1500	2000
1	66	52	46	40	31	29	26	....	....
1¼	118	97	84	75	61	53	47	43	38
1½	195	154	133	123	101	87	79	72	62
2	450	375	325	295	250	210	185	175	150
2½	725	600	525	480	400	340	300	275	245
3	1350	1100	940	850	700	625	600	500	430
3½	1950	1575	1360	1250	1000	900	800	725	625
4	2725	2225	1910	1725	1400	1250	1100	1025	875
4½	3625	2960	2550	2300	1875	1650	1500	1375	1175
5	4850	3975	3410	3090	2500	2225	2000	1825	1600
6	7775	6400	5475	4850	4025	3600	3200	2900	2540
7	11500	9325	7960	7100	5800	5100	4700	4175	3660
8	16000	13000	11200	10000	8100	6800	6300	6000	5100
9	22000	17000	15000	13500	11000	9400	8400	7800	6850
10	29000	23300	20000	18000	14600	12700	11500	10500	9120
12	45000	36750	31810	28400	23000	19700	18100	16800	16200
14	60000	47400	41000	36500	29500	25800	23500	21400	18600
15	70000	57000	49100	43500	35500	30500	27700	25500	22000
16	85000	70000	60500	54000	43600	37900	34200	31000	27000

Capacities of Mains and Risers
As Applied to the Vacuum System of Steam Circulation
ONE HALF POUND PRESSURE LOSS

Size of Supply Inches	Length of supply and return piping in feet from source of supply to farthest radiator. Allowance for elbows and valves must be added to measured distance. Pipe capacities in square feet of direct cast iron radiation are given for each length. Supply risers are based on length of supply, Return riser, ¾″ up to 800 sq. ft.; 1″ to 1500 sq. ft.; 1¼″ to 2400 sq.ft.							
	200	300	400	500	750	1000	1250	1500
1	92	72	64	56	44	40	36	....
1¼	166	136	118	100	86	74	66	60
1½	274	216	188	172	142	122	110	102
2	632	528	456	414	350	294	260	246
2½	1020	850	720	676	564	480	420	386
3	1900	1420	1320	1174	964	880	840	700
3½	2740	2200	1910	1760	1404	1264	1120	1020
4	3800	3120	2680	2420	1970	1760	1550	1440
4½	5100	4160	3580	3240	2630	2320	2100	1930
5	6820	5580	4800	4340	3510	3120	2810	2560
6	10920	9000	7700	6800	5650	5060	4500	4080
7	16200	13100	11200	10000	8150	7160	6600	5860
8	22500	18300	15700	14040	11400	9550	8850	8440
9	30900	23900	21100	19000	14500	13200	11800	10950
10	40800	32700	28100	25300	20500	17900	16200	14750
12	63200	51500	44600	40000	32300	27800	25400	23600
14	84400	66600	57600	51200	41400	36200	33000	30000
15	98800	80000	68200	61000	49800	42800	38800	35800
16	119500	98500	85000	75800	59800	53200	48000	43600

Capacities of Mains and Risers
As Applied to the Vacuum System of Steam Circulation
THREE QUARTER POUND PRESSURE LOSS

Size of Supply Inches	Length of supply and return piping in feet from source of supply to farthest radiator. Allowance for elbows and valves must be added to measured distance. Pipe capacities in square feet of direct cast iron radiation are given for each length. Supply risers are based on length of supply, Return riser, ¾″ up to 800 sq. ft.; 1″ to 1500 sq. ft.; 1¼″ to 2400 sq.ft.								
	200	300	400	500	750	1000	1250	1500	2000
1	101	83	75	67	52	50	46	40	35
1¼	184	156	138	123	105	92	83	76	70
1½	305	251	221	204	173	152	139	128	120
2	690	593	522	476	409	354	320	298	280
2½	1156	1012	880	814	693	605	546	500	485
3	2083	1720	1543	1398	1179	1069	1020	876	830
3½	3046	2565	2273	2093	1731	1573	1430	1302	1240
4	4299	3648	3206	2915	2440	2203	1993	1839	1745
4½	5670	4846	4313	3908	3268	2943	2726	2493	2350
5	7660	6533	5766	5255	4400	3986	3670	3328	3200
6	12383	10612	9380	8395	7143	6453	5873	5113	4780
7	18376	15592	13746	12426	10146	9392	8763	7876	7300
8	25726	21910	19449	17563	14721	12772	11926	11187	10500
9	35023	28815	26006	23678	19659	17599	16130	14843	14000
10	46283	39085	34653	31558	26573	23715	21913	20030	19000
12	72356	61925	55293	50202	42292	37447	34893	32256	32000
14	102200	80700	75300	68372	57935	52048	48436	44280	42000
15	119800	97000	85200	74000	60400	58775	53318	48540	44000
16	144750	119250	103000	91900	73500	64500	58200	52800	48000

Capacities of Mains and Risers

As Applied to the Vacuum System of Steam Circulation

ONE POUND PRESSURE LOSS

Length of supply and return piping in feet from source of supply to farthest radiator.
Allowance for elbows and valves must be added to measured distance.
Pipe capacities in square feet of direct cast iron radiation are given for each length.
Supply risers are based on length of supply, Return riser, ¾″ up to 800 sq. ft.; 1″ to 1500 sq. ft.; 1¼″ to 2400 sq. ft.

Size of Supply Inches	200	300	400	500	750	1000	1250	1500	2000
1	132	104	92	80	62	58	52	....	....
1¼	236	194	168	150	122	106	94	86	76
1½	390	308	266	246	202	174	158	144	124
2	900	750	650	590	500	420	370	350	300
2½	1450	1200	1050	960	800	680	600	550	490
3	2700	2200	1880	1700	1400	1250	1200	1000	860
3½	3900	3150	2720	2500	2000	1800	1600	1450	1250
4	5450	4450	3820	3450	2800	2500	2200	2050	1750
4½	7250	5920	5100	4600	3750	3300	3000	2750	2350
5	9700	7950	6820	6180	5000	4450	4000	3650	3200
6	15550	12800	10950	9700	8050	7200	6400	5800	5080
7	23000	18650	15920	14200	11600	10200	9400	8350	7320
8	32000	26000	22400	20000	16200	13600	12600	12000	10200
9	44000	34000	30000	27000	22000	18800	16800	15600	13700
10	58000	46600	40000	36000	29200	25400	23000	21000	18240
12	90000	73500	63600	56800	46000	39400	36200	33600	32400
14	120000	94800	82000	73000	59000	51600	47000	42800	37200
15	140000	114000	98200	87000	71000	61000	55400	51000	44000
16	170000	140000	121000	108000	87200	75800	68400	62000	54400

Capacities of Return Mains

As Applied to Vacuum Systems of Steam Circulation

Length of return piping in feet from suction of pump to farthest radiator.
Allowance for elbows and lifts must be added to measured distance.
Pipe capacities in square feet of direct cast iron radiation given for each length.
Based on one third of a pound of condensation per square foot per hour.

Size of Return	100	200	300	400	500	600	700	800	900	1000	1250	1500
1	1500	1450	1400	1200	......	......	......	......	......	......	......	......
1¼	3200	3150	3100	2500	2500	......	......	......	......	......	......	......
1½	5000	4500	4000	3500	3250	3000	2900	2800	......	......	......	......
2	8000	7000	6250	5775	5000	4850	4500	4250	4100	4000	......	......
2½	11000	10500	9500	9000	8000	7250	6950	6250	6000	5000	4900	4500
3	19000	18000	16500	15000	14000	13000	12000	11500	10900	10500	9750	8500
3½	28000	26000	24500	23000	22000	20700	19900	18000	17500	17000	16000	15000
4	40000	38000	36000	34500	32700	31200	30000	28700	28000	27000	25200	24500
4½	54500	51700	49500	47000	45000	43500	41700	40000	39000	37500	35000	33750
5	71000	67500	64000	61000	58000	55000	52700	50700	49000	47500	44000	41700
6	91000	87000	83000	80000	76500	73500	71000	68500	66500	64500	60500	57700
7	115500	111500	108000	104000	101500	97700	94500	92000	90000	87000	82000	78500
8	146000	141500	137000	133000	129500	126000	122500	119500	116500	114000	107500	102000

Flow of Steam in Pipes

Pressure Drop in Ounces	$87\sqrt{\frac{Drop}{100}}$	Inside Diameter Pipe, Inches	$\sqrt{\frac{D^5}{1+\frac{3.6}{D}}}$	Steam Pressure	$\sqrt{Density}$	Length Pipe in Inches	$\sqrt{\frac{100}{Length}}$
1	2.175	1	.522	0	.193	20	2.240
2	3.076	1¼	1.177	.3	.195	40	1.580
3	3.767	1½	1.828	1.3	.201	60	1.290
4	4.350	2	3.709	2.3	.207	80	1.120
5	4.863	2½	6.109	5.3	.223	100	1.000
6	5.328	3	11.183	10.3	.248	120	.912
7	5.754	3½	16.705	15.3	.270	140	.841
8	6.152	4	23.630	20.3	.290	160	.793
10	6.878	4½	32.098	30.3	.326	180	.741
12	7.534	5	43.719	40.3	.358	200	.710
14	8.138	6	69.718	50.3	.388	250	.632
16	8.700	7	105.35	60.3	.415	300	.578
20	9.727	8	150.33	75.3	.452	350	.538
24	10.655	9	205.37	100.3	.507	400	.500
28	11.509	10	271.16	125.3	.557	450	.477
32	12.290	12	437.51	150.3	.603	500	.447
40	13.756	14	733.90	175.3	.645	600	.407
48	15.069	16	925.19	200.3	.648	700	.378
80	19.454					800	.354
160	27.512					900	.333
320	38.863					1000	.316
480	47.652					1400	.267

A×B×C×D=lbs. steam per minute will flow through a pipe for a given condition. Example.—

4.35×11.183×223×1.00=10.84 lbs. per minute—10.84×60=650.4 lbs. per hour.

p =drop in pressure in lbs.
d =inside diameter pipe in inches
L =length of pipe in feet
D =density of steam per cu. ft.
W=lbs. of steam per minute

$$W = \sqrt{\frac{PDd^5}{\left(1+\frac{3.6}{d}\right)L}}$$

$$P = .000131\left(1+\frac{3.6}{d}\right)\frac{W^2L}{Dd^5}$$

Properties of Saturated Steam

Vacuum in Inches of Mercury or Gage Pressure in Pounds	Absolute Pressure in lbs. per sq. in.	Temper-ture in Degrees Fahr.	Total Heat Above 32° fahr.		Latent Heat of the Steam in B.t.u.	Volume in cu. ft. of 1 lb. of Steam
			B.t.u. in the Water	B.t.u. in the Steam		
27.88	1.	101.83	69.8	1104.4	1034.6	333.0
25.85	2.	126.15	94.0	1115.0	1021.0	173.5
23.81	3.	141.52	109.4	1121.6	1012.3	118.5
21.78	4.	153.01	120.9	1126.5	1005.7	90.5
19.74	5.	162.28	130.1	1130.5	1000.3	73.33
17.70	6.	170.06	137.9	1133.7	995.8	61.89
15.67	7.	176.85	144.7	1136.5	991.8	53.56
13.63	8.	182.86	150.8	1139.0	988.2	47.27
11.60	9.	188.27	156.2	1141.1	985.0	42.36
9.56	10.	193.22	161.1	1143.1	982.0	38.38
7.52	11.	197.75	165.7	1144.9	979.2	35.10
5.49	12.	201.96	169.9	1146.5	976.6	32.36
3.45	13.	205.87	173.8	1148.0	974.2	30.03
1.42	14.	209.55	177.5	1149.4	971.9	28.02
0.00	14.70	212.00	180.0	1150.4	970.4	26.79
0.3	15.	213.00	181.0	1150.7	969.7	26.27
1.3	16.	216.3	184.4	1152.0	967.6	24.79
2.3	17.	219.4	187.5	1153.1	965.6	23.38
3.3	18.	222.4	190.5	1154.2	963.7	22.16
4.3	19.	225.2	193.4	1155.2	961.8	21.07
5.3	20.	228.0	196.1	1156.2	960.0	20.08
6.3	21.	230.6	198.8	1157.1	958.3	19.18
7.3	22.	233.1	201.3	1158.0	956.7	18.37
8.3	23.	235.5	203.8	1158.8	955.1	17.62
9.3	24.	237.8	206.1	1159.6	953.5	16.93
10.3	25.	240.1	208.4	1160.4	952.0	16.30
15.3	30.	250.3	218.8	1163.9	945.1	13.74
20.3	35.	259.3	227.3	1166.8	938.9	11.89
25.3	40.	267.3	236.1	1169.4	933.3	10.49
31.3	46.	275.8	244.8	1172.0	927.2	9.20
35.3	50.	281.0	250.1	1173.6	923.5	8.51
41.3	56.	288.2	257.5	1175.7	918.2	7.65
45.3	60.	292.7	262.1	1177.0	914.9	7.17
51.3	66.	299.0	268.5	1178.8	910.2	6.56
61.3	76.	308.5	278.3	1181.4	903.0	5.74
71.3	86.	317.1	287.2	1183.6	896.4	5.10
81.3	96.	324.9	295.3	1185.6	890.3	4.60
90.3	105.	331.4	302.0	1187.2	885.2	4.23
100.3	115.	338.1	309.0	1188.8	879.8	3.88
125.3	140.	353.1	324.6	1192.2	867.6	3.219
140.3	155.	361.1	332.9	1194.0	861.0	2.920
150.3	165.	366.1	338.2	1195.0	856.8	2.753
165.3	180.	373.1	345.6	1196.4	850.8	2.533
175.3	190.	377.6	350.4	1197.3	846.9	2.406
200.3	215.	388.0	361.4	1199.2	837.9	2.138

Diameter or Side of Chimney

(in Inches) Required for Varying Amounts of Direct Steam Radiating Surface

HEIGHT OF CHIMNEY IN FEET	20	30	40	50	60	80	100	120
SQUARE FEET OF DIRECT STEAM RADIATION	DIMENSIONS GIVEN ARE INSIDE MEASUREMENTS							
250	7.4	7.0	6.7	6.4	6.2	6.0	6.0	6.0
500	.....	9.2	8.8	8.2	8.0	6.6	7.3	7.0
750	.....	10.8	10.2	9.6	9.3	8.8	8.5	8.2
1000	.....	12.0	11.4	10.8	10.5	10.0	9.5	9.2
1500	.....	14.4	13.4	12.8	12.4	11.5	11.2	10.8
2000	.....	16.3	15.2	14.5	14.0	13.2	12.6	12.1
3000	.....	18.5	18.2	17.2	16.6	15.8	15.0	14.4
4000	.....	22.2	20.8	19.6	19.0	17.8	17.0	16.3
5000	.....	24.6	23.0	21.6	21.0	19.4	18.6	18.0
6000	.....	26.8	25.0	23.4	22.8	21.2	20.2	19.5
7000	.....	28.8	27.0	25.5	24.4	23.0	21.6	20.8
8000	.....	30.6	28.6	26.8	26.0	24.2	23.4	22.2
9000	.....	32.4	30.4	28.4	27.4	25.6	24.4	23.4
10000	.....	34.0	32.0	30.0	28.6	27.0	25.4	24.6
15000	.....	.....	38.4	36.2	35.0	33.0	31.0	29.2
20000	.....	.....	43.0	42.0	41.0	37.0	35.0	34.0
30000	.....	.....	.....	50.0	48.0	46.0	43.0	41.0

Storage of Fuel per Thousand Pounds

Prepared Stove Size

Hard Coal	18 Cubic Feet
Soft Coal	20 Cubic Feet
Coke	34 Cubic Feet
Cord Wood	38 Cubic Feet
Oil	18 Cubic Feet

Chimney Capacities in Horse Power

Horse Power = $3.33\,(A - 0.6\sqrt{A})\sqrt{H}$

Diam. in inches	Area-A in Sq. Ft.	Effective Area $E = A - .6\sqrt{A}$ Sq. Ft.	Height of Chimney in Feet: 50	60	70	80	90	100	110	125	150	175	200	225	250	300	Equivalent Sq. Chimney—Side of Sq. $\sqrt{E}+4$
			Commercial Horse Power of Boiler														
18	1.77	0.97	23	25	27	29											16
21	2.41	1.47	35	38	41	44											19
24	3.14	2.08	49	54	58	62	66										22
27	3.98	2.78	65	72	78	83	88										24
30	4.91	3.58	84	92	100	107	113	119									27
33	5.94	4.48	115	115	125	133	141	149	156								30
36	7.07	5.47		141	152	163	173	182	191	204							32
39	8.30	6.57			183	196	208	219	229	245	268						35
42	9.62	7.76			216	231	245	258	271	289	316	342					38
48	12.57	10.44				311	330	348	365	389	426	460	492				43
54	15.90	13.51					427	449	472	503	551	595	636	675			48
60	19.64	16.98					536	565	593	632	692	748	800	848	894		54
66	23.76	20.83						694	728	776	849	918	981	1040	1097	1201	59
72	28.27	25.08						835	876	934	1023	1105	1181	1253	1320	1447	64
78	33.18	29.73							1038	1107	1212	1310	1400	1485	1565	1715	70
84	38.48	34.76							1214	1294	1418	1531	1637	1736	1830	2005	75
90	44.18	40.19								1496	1639	1770	1893	2008	2116	2318	80
96	50.27	46.01								1712	1876	2027	2167	2298	2423	2654	86
102	56.75	52.23								1944	2130	2300	2459	2609	2750	3012	91
108	63.62	58.83								2090	2399	2592	2771	2939	3098	3393	96
114	70.88	65.83									26.85	2900	3100	3288	3466	3797	101
120	78.54	73.22									2986	3226	3448	3657	3855	4223	107
132	95.03	89.18									3637	3929	4200	4455	4696	5144	117
144	113.10	106.72									4352	4701	5026	5331	5618	6155	128

Practical Heights of Chimneys

Using Free Burning Bituminous Coal..... 75 feet
Anthracite of Medium and Large Size....100 feet
Slow Burning Bituminous Coal..........120 feet
Anthracite Pea Coal...................130 feet
Anthracite Buckwheat..................150 feet
Plants 700 H.P. and Over not less than...150 feet

Flue Diameters

Required for the Passage of Given Volumes of Air at Various Standard Velocities

CU. FT. OF AIR PER MINUTE	500	600	700	800	900	1000	1200	1500	1800	2000	2200	2500	2800	3000	3500	4000
200	9	8	8	7	7	7	6	6	6	6	6	6	6	6	6	6
300	11	10	9	9	8	8	7	7	6	6	6	6	6	6	6	6
400	13	11	11	10	9	9	8	8	7	7	6	6	6	6	6	6
500	14	13	12	11	11	10	9	8	8	7	7	7	6	6	6	6
600	15	14	13	12	11	11	10	9	8	8	8	7	7	7	6	6
700	16	15	14	13	12	12	11	10	9	9	8	8	7	7	7	6
800	18	16	15	14	13	13	12	10	9	9	9	8	8	8	7	7
900	19	17	16	15	14	13	12	11	10	10	9	9	8	8	8	7
1000	20	18	16	16	15	14	13	12	10	10	10	9	9	8	8	7
1100	21	19	18	16	16	15	13	12	11	11	10	9	9	9	8	8
1200	21	20	18	17	16	15	14	13	11	11	10	10	9	9	9	8
1300	22	20	19	18	17	16	15	13	12	11	11	10	10	10	9	8
1400	23	21	20	18	17	16	15	14	12	12	11	11	10	10	9	9
1500	24	22	20	19	18	17	16	14	13	12	12	11	10	10	9	9
1600	25	23	21	20	18	18	16	15	13	13	12	11	11	11	10	9
1700	25	24	21	20	19	18	17	15	14	13	12	12	11	11	10	9
1800	26	24	22	21	20	19	17	15	14	13	13	12	11	11	10	10
1900	27	24	23	21	20	19	18	16	14	14	13	12	12	11	10	10
2000	28	25	23	22	21	20	18	16	15	14	13	13	12	12	11	10
2100	28	26	24	22	21	20	18	16	15	14	14	13	12	12	11	10
2200	29	27	24	23	22	21	19	17	15	15	14	13	12	12	11	11
2300	30	27	25	23	22	21	19	17	16	15	15	13	13	12	11	11
2400	30	28	25	24	23	21	20	18	16	15	15	14	13	13	12	11
2500	31	28	26	24	23	22	20	18	16	16	15	14	13	13	12	11
2600	31	29	27	25	23	22	20	18	17	16	15	15	14	13	12	11
2700	32	29	27	25	24	23	21	19	17	16	15	15	14	13	12	12
2800	33	30	28	26	24	23	21	19	18	16	16	15	14	14	13	12
2900	33	30	28	26	25	24	22	19	18	17	16	15	14	14	13	12
3000	34	31	29	27	25	24	22	20	18	17	16	15	15	14	13	12
3100	34	31	29	27	26	24	22	20	18	17	17	15	15	14	13	12
3200	34	32	30	28	26	25	23	20	19	18	17	15	15	15	13	13
3300	35	32	30	28	26	25	23	21	19	18	17	16	15	15	14	13
3400	36	33	30	28	27	25	23	21	19	18	17	16	15	15	14	13
3500	36	33	31	29	27	26	24	21	19	18	18	16	16	15	15	14
3600	37	34	31	29	28	26	24	21	20	19	18	16	16	15	15	14
3700	37	34	32	30	28	27	24	22	20	19	18	17	16	16	14	14
3800	38	35	32	30	28	27	25	22	21	19	18	17	16	16	15	14
3900	38	35	32	30	29	27	25	22	21	19	19	17	16	16	15	14
4000	39	35	33	31	29	28	25	22	21	20	19	18	17	16	15	14
4100	39	36	33	31	29	28	26	23	21	20	19	18	17	16	15	14
4200	40	36	34	32	30	28	26	23	21	20	19	18	17	16	15	14
4300	40	37	34	32	30	29	26	23	21	20	19	18	17	17	15	15
4400	41	37	34	32	30	29	26	24	22	21	20	18	17	17	16	15
4500	41	38	35	33	31	29	27	24	22	21	20	19	18	17	16	15
4600	42	38	35	33	31	30	27	24	22	21	20	19	18	17	16	15

Flue Diameters

Required for the Passage of Given Volumes of Air at Various Standard Velocities

CU. FT. OF AIR PER MINUTE	500	600	700	800	900	1000	1200	1500	1800	2000	2200	2500	2800	3000	3500	4000
4700	42	38	36	34	31	30	27	24	22	21	20	19	18	17	16	15
4800	42	39	36	34	32	30	28	25	22	21	20	19	18	18	16	15
4900	43	39	36	34	32	30	28	25	23	22	21	19	18	18	16	16
5000	43	40	37	34	32	31	28	25	23	22	21	20	19	18	17	16
5100	43	40	37	35	33	31	28	25	23	22	21	20	19	18	17	16
5200	44	40	37	35	33	31	29	25	24	22	21	20	19	18	17	16
5300	45	41	38	35	33	32	29	26	24	23	22	20	19	18	17	16
5400	45	41	38	35	33	32	29	26	24	23	22	21	19	18	18	16
5500	45	41	38	36	34	32	29	26	24	23	22	21	19	18	18	16
5600	45	41	39	36	34	33	30	27	24	23	22	21	20	19	18	17
5700	46	42	39	37	34	33	30	27	24	23	22	21	20	19	18	17
5800	46	42	39	37	35	33	30	27	25	24	22	21	20	19	18	17
5900	46	42	40	37	36	33	30	27	25	24	22	21	20	19	18	17
6000	47	43	40	38	36	34	31	28	25	24	23	21	20	20	18	17
6100	47	43	40	38	36	34	31	28	25	24	23	21	20	20	18	17
6200	48	43	41	38	36	34	31	28	25	24	23	21	21	20	18	17
6300	48	44	41	38	36	34	31	28	25	24	23	22	21	20	18	17
6400	48	44	41	39	37	35	32	28	26	25	24	22	21	20	19	18
6500	49	44	41	39	37	36	32	29	26	25	24	22	21	20	19	18
6600	50	45	42	39	37	36	32	29	26	25	24	22	21	21	19	18
6700	50	45	42	40	37	36	32	29	27	25	24	22	21	21	19	18
6800	50	46	43	40	38	36	33	29	27	25	24	23	21	21	19	18
6900	50	46	43	40	38	36	33	30	27	25	24	23	21	21	19	18
7000	51	46	43	40	38	36	33	30	27	26	24	23	22	21	20	19
7100	51	46	44	41	38	37	33	30	27	26	25	23	22	21	20	19
7200	52	47	44	41	39	37	34	30	28	26	25	23	22	21	20	19
7300	53	47	44	41	39	37	34	30	28	26	25	24	22	21	20	19
7400	53	48	44	41	39	37	34	30	28	27	25	24	22	21	20	19
7500	53	48	45	42	40	38	34	31	28	27	25	24	22	21	20	19
7600	53	48	45	42	40	38	34	31	28	27	25	24	23	22	20	19
7700	53	49	45	42	40	38	35	31	28	27	26	24	23	22	21	19
7800	54	49	46	43	40	38	36	31	29	27	26	24	23	22	21	19
7900	54	49	46	43	40	39	36	31	29	27	26	24	23	22	21	19
8000	54	49	46	43	41	39	36	32	29	28	26	25	24	22	21	20
8100	55	50	46	43	41	39	36	32	29	28	26	25	24	23	21	20
8200	55	50	46	43	41	39	36	32	29	28	27	25	24	23	21	20
8300	55	50	47	43	41	40	36	32	30	28	27	25	24	23	21	20
8400	56	51	47	44	41	40	36	33	30	28	27	25	24	23	21	20
8500	56	51	47	44	41	40	36	33	30	28	27	25	24	23	21	20
8600	56	51	48	44	42	40	37	33	30	29	27	25	24	23	21	20
8700	56	52	48	45	42	40	37	33	30	29	28	25	24	24	21	20
8800	57	52	48	45	42	41	37	33	30	29	28	26	24	24	22	21
8900	57	52	48	45	43	41	37	33	30	29	28	26	24	24	22	21
9000	57	52	49	45	43	41	38	34	31	29	28	26	25	24	22	21
9100	58	53	49	46	43	41	38	34	31	29	28	26	25	24	22	21

Flue Diameters

Required for the Passage of Given Volumes of Air at Various Standard Velocities

CU. FT. OF AIR PER MINUTE	500	600	700	800	900	1000	1200	1500	1800	2000	2200	2500	2800	3000	3500	4000
9200	58	53	49	46	43	41	38	34	31	30	28	26	25	24	22	21
9300	58	53	49	46	44	42	38	34	31	30	28	27	25	24	22	21
9400	59	53	50	46	44	42	38	34	31	30	28	27	25	24	22	21
9500	59	54	50	47	44	42	39	34	31	30	29	27	25	24	23	21
9600	59	54	50	47	44	42	39	35	32	30	29	27	25	25	23	21
9700	60	54	51	47	45	43	39	35	32	30	29	27	25	25	23	21
9800	60	55	51	47	45	43	39	36	32	30	29	27	26	25	23	21
9900	60	55	51	48	45	43	39	36	32	30	29	27	26	25	23	21
10000	61	55	52	48	45	43	40	36	32	31	29	28	26	25	23	22
10500	61	57	53	49	46	44	41	36	32	31	30	28	27	26	24	22
11000	62	58	54	50	47	45	41	37	33	31	31	29	27	26	24	23
11500	62	59	55	51	48	46	42	37	34	32	31	30	28	27	25	23
12000	63	60	56	52	49	47	43	39	35	34	32	30	28	28	25	24
12500	64	61	57	53	50	48	44	40	36	34	33	31	30	28	26	24
13000	65	62	58	54	51	49	45	40	37	35	33	31	30	29	27	25
13500	70	64	59	56	52	50	46	41	38	35	34	32	30	29	27	25
14000	72	65	61	57	53	51	47	42	38	36	34	33	31	30	28	26
14500	73	66	61	57	54	52	47	42	39	37	35	33	31	30	28	26
15000	74	68	62	59	56	53	48	43	40	38	36	34	32	31	28	27
15500	75	69	64	59	56	54	49	44	40	38	36	35	32	31	29	27
16000	77	70	65	60	59	55	50	45	41	39	37	35	33	32	29	28
16500	78	71	65	61	59	56	51	45	41	39	38	36	33	32	30	28
17000	79	73	66	62	59	56	51	46	42	40	38	36	34	33	30	28
17500	80	73	68	64	59	57	52	47	43	40	39	37	34	33	31	29
18000	81	74	68	64	60	58	53	47	43	41	39	37	35	34	31	29
18500	82	75	70	65	60	59	54	48	44	42	40	38	35	34	31	30
19000	83	75	70	65	62	60	54	49	44	42	40	38	35	34	32	30
19500	85	77	72	67	62	60	55	49	45	43	41	39	36	35	32	30
20000	86	78	73	68	64	61	56	50	46	43	41	39	37	35	33	31
20500	87	79	73	68	64	62	56	50	46	44	42	39	37	36	33	31
21000	88	80	74	69	65	63	57	51	47	44	42	40	38	36	34	31
21500	89	81	74	70	66	63	58	52	47	45	43	40	38	37	34	32
22000	90	81	75	70	66	64	58	52	48	45	43	41	38	37	34	32
22500	91	82	77	72	68	65	59	53	48	46	44	41	39	38	35	33
23000	92	83	78	73	68	65	60	53	49	46	44	42	39	38	35	33
23500	93	85	79	73	69	66	60	54	49	47	45	42	40	38	35	33
24000	94	86	79	74	69	67	61	55	50	47	45	42	40	39	36	34
24500	95	87	80	74	71	68	62	55	50	48	45	43	40	39	36	34
25000	96	87	80	75	72	68	62	56	51	48	46	43	41	40	37	34
25500	97	88	81	77	72	69	63	56	51	49	46	44	41	40	37	34
26000	98	89	82	77	73	70	63	57	52	49	47	44	42	40	38	35
26500	99	90	83	78	73	70	64	57	52	50	47	45	42	41	38	35
27000	100	91	83	79	74	71	65	58	53	50	48	45	42	41	38	36
27500	101	92	85	79	74	72	65	58	53	51	48	45	43	41	38	36
28000	102	92	86	80	75	72	66	59	54	51	49	46	43	42	39	36

Flue Diameters

Required for the Passage of Given Volumes of Air at Various Standard Velocities

CU. FT. OF AIR PER MINUTE	500	600	700	800	900	1000	1200	1500	1800	2000	2200	2500	2800	3000	3500	4000
28500	103	93	87	80	76	73	66	60	54	52	49	46	44	42	39	37
29000	104	94	87	81	77	73	67	60	55	52	50	47	44	42	39	37
29500	105	95	88	82	77	74	68	60	55	52	50	47	44	43	40	37
30000	106	96	89	82	78	75	68	61	56	53	50	47	45	43	40	38
30500	107	97	89	83	79	75	69	62	56	53	51	48	45	44	40	38
31000	107	97	90	85	79	76	69	62	57	54	51	48	45	44	41	38
31500	108	98	91	85	80	76	70	63	57	54	52	49	46	44	41	39
32000	109	99	91	86	80	77	70	63	57	55	52	49	46	45	41	39
32500	110	100	92	86	81	78	71	63	58	55	52	49	47	45	42	39
33000	110	101	93	87	81	78	72	64	58	56	53	50	47	45	42	39
33500	111	102	94	88	82	79	72	64	59	56	53	50	47	46	42	40
34000	112	102	94	88	83	79	73	65	59	56	54	50	48	46	43	40
34500	113	103	95	89	85	80	73	65	60	57	54	51	48	46	43	40
35000	114	104	96	90	85	81	74	66	60	57	54	51	48	47	43	40
35500	115	105	96	90	86	81	74	66	61	57	55	52	49	47	44	41
36000	115	106	97	91	86	82	75	67	61	58	55	52	49	47	44	41
36500	116	106	98	91	87	82	75	67	61	58	56	52	49	48	44	41
37000	117	107	99	92	87	83	76	68	62	59	56	52	50	48	44	42
37500	118	107	100	93	88	83	76	68	62	59	56	53	50	48	45	42
38000	119	108	101	93	88	84	77	69	63	60	57	53	50	49	45	42
38500	119	109	102	94	89	85	77	69	63	60	57	54	51	49	45	42
39000	120	110	102	95	89	85	78	70	63	60	57	54	51	49	46	43
39500	121	110	103	95	90	86	78	70	64	61	58	54	51	50	46	43
40000	122	110	103	96	90	86	79	71	64	61	58	55	52	50	46	43
40500	122	111	104	96	91	87	79	71	65	61	59	55	52	50	46	44
41000	123	112	104	97	91	88	79	71	65	62	59	55	52	50	47	44
41500	124	113	105	98	92	88	80	72	65	62	59	56	52	50	47	44
42000	125	114	105	98	92	88	81	72	66	63	60	56	53	51	47	44
42500	125	115	106	99	93	89	81	73	66	63	60	56	53	51	48	44
43000	126	115	106	99	93	89	82	73	66	63	60	57	53	51	48	44
43500	127	116	107	100	94	90	82	73	67	63	61	57	53	51	48	45
44000	127	116	108	101	95	90	82	74	67	64	61	57	54	52	48	45
44500	128	117	108	101	95	91	83	74	68	64	61	58	54	52	49	46
45000	129	118	109	102	96	91	83	75	68	65	62	58	55	53	49	46
45500	130	119	110	102	96	92	84	75	68	65	62	58	55	53	49	46
46000	130	119	110	103	97	93	84	75	69	65	62	59	55	53	50	46
46500	131	120	110	103	97	93	85	76	69	66	63	59	56	54	50	47
47000	132	120	111	104	98	93	85	76	70	66	63	59	56	54	50	47
47500	132	121	112	104	99	94	86	77	70	66	63	60	56	54	50	47
48000	133	122	113	105	100	95	86	77	70	67	64	60	56	55	50	47
48500	....	....	113	105	100	95	87	77	71	67	64	60	57	55	51	47
49000	....	....	114	106	100	95	87	78	71	68	64	60	57	55	51	48
49500	....	....	114	107	101	96	87	78	72	68	65	61	57	56	51	48
50000	....	....	115	107	101	96	88	79	72	68	65	61	58	56	51	48
50500	....	....	115	108	102	97	88	79	72	68	65	61	58	56	52	49

Flue Diameters

Required for the Passage of Given Volumes of Air at Various Standard Velocities

CU. FT. OF AIR PER MINUTE	500	600	700	800	900	1000	1200	1500	1800	2000	2200	2500	2800	3000	3500	4000
51000			115	108	102	97	89	79	73	69	66	62	58	56	52	49
51500			116	109	103	98	89	80	73	69	66	62	58	56	52	49
52000			117	110	103	98	90	80	73	70	66	62	59	57	53	49
52500			118	110	104	99	90	81	74	70	67	63	59	57	53	50
53000			118	110	104	99	90	81	74	70	67	63	59	57	53	50
53500			119	111	104	99	91	81	74	70	67	63	60	58	53	50
54000			119	111	105	100	91	82	75	71	68	63	60	58	54	50
54500			120	112	105	100	92	82	75	71	68	64	60	58	54	50
55000				113	106	101	92	82	75	72	68	64	60	58	54	51
55500				113	106	101	93	83	76	72	68	64	61	59	54	51
56000				114	107	102	93	83	76	72	69	65	61	59	55	51
56500				114	107	102	93	84	76	72	69	65	61	59	55	51
57000				115	108	103	94	84	77	73	69	65	62	60	55	52
57500				115	109	103	94	84	77	73	70	65	62	60	55	52
58000				116	109	104	95	85	77	73	70	66	62	60	56	52
58500				116	110	104	95	85	78	74	70	66	62	60	56	52
59000				117	110	104	95	85	78	74	71	66	63	60	56	52
59500				117	110	105	96	86	78	74	71	67	63	61	56	53
60000				118	110	105	96	86	79	75	71	67	63	61	57	53
60500				118	111	106	97	86	79	75	72	67	63	61	57	53
61000				119	111	106	97	87	79	75	72	67	64	62	57	53
61500				119	112	107	97	87	80	76	72	68	64	62	57	53
62000				120	113	107	98	88	80	76	72	68	64	62	57	54
62500					113	108	98	88	80	76	73	68	64	62	58	54
63000					114	108	98	88	80	76	73	68	65	63	58	54
63500					114	109	99	89	80	77	73	69	65	63	58	54
64000					115	109	99	89	81	77	73	69	65	63	58	55
64500					115	110	100	89	81	77	74	69	65	63	58	55
65000					115	110	100	90	81	78	74	70	66	64	59	55
65500					116	110	101	90	82	78	74	70	66	64	59	55

Flue Diameters

Required for the Passage of Given Volumes of Air at Various Standard Velocities

Cu. Ft. Air per Min.	2000	2200	2500	2800	3000	3500	4000	Cu. Ft. Air per Min.	2000	2200	2500	2800	3000	3500	4000
66000	78	75	70	66	64	59	56	83500	88	84	79	74	72	67	62
66500	79	75	70	66	64	60	56	84000	88	84	79	75	72	67	63
67000	79	75	71	67	64	60	56	84500	88	84	79	75	72	67	63
67500	79	75	71	67	65	60	56	85000	89	85	79	75	73	67	63
68000	79	76	71	67	65	60	56	85500	89	85	80	75	73	67	63
68500	80	76	71	67	65	60	57	86000	89	85	80	76	73	68	63
69000	80	76	71	68	65	61	57	86500	89	85	80	76	73	68	63
69500	80	76	72	68	66	61	57	87000	90	86	80	76	74	68	64
70000	81	77	72	68	66	61	57	87500	90	86	81	76	74	68	64
70500	81	77	72	68	66	61	57	88000	90	86	81	76	74	68	64
71000	81	77	73	69	66	61	57	88500	91	86	81	77	74	68	64
71500	81	78	73	69	67	62	58	89000	91	87	81	77	74	69	64
72000	82	78	73	69	67	62	58	89500	91	87	82	77	74	69	64
72500	82	78	73	69	67	62	58	90000	91	87	82	77	75	69	65
73000	82	78	74	70	67	62	58	90500	92	87	82	77	75	69	65
73500	82	79	74	70	68	63	58	91000	92	88	82	78	75	70	65
74000	83	79	74	70	68	63	59	91500	92	88	82	78	75	70	65
74500	83	79	74	70	68	63	59	92000	92	88	83	78	75	70	65
75000	83	79	75	71	68	63	59	92500	93	88	83	79	76	70	66
75500	84	80	75	71	68	63	59	93000	93	89	83	79	76	70	66
76000	84	80	75	71	69	64	60	93500	93	89	83	79	76	70	66
76500	84	80	75	71	69	64	60	94000	93	89	84	79	76	71	66
77000	85	81	76	72	69	64	60	94500	94	89	84	79	76	71	66
77500	85	81	76	72	69	64	60	95000	94	89	84	79	77	71	66
78000	85	81	76	72	70	64	60	95500	94	90	84	80	77	71	67
78500	85	81	76	72	70	65	60	96000	94	90	84	80	77	71	67
79000	86	82	77	72	70	65	61	96500	95	90	84	80	77	72	67
79500	86	82	77	73	70	65	61	97000	95	90	85	80	77	72	67
80000	86	82	77	73	70	65	61	97500	95	90	85	80	78	72	67
80500	86	82	77	73	71	65	61	98000	95	91	85	81	78	72	68
81000	87	83	78	73	71	66	61	98500	95	91	85	81	78	62	68
81500	87	83	78	74	71	66	62	99000	96	91	86	81	78	72	68
82000	87	83	78	74	71	66	62	99500	96	92	86	81	78	73	68
82500	87	83	78	74	72	66	62	100000	96	92	86	81	79	73	68
83000	88	84	79	74	72	66	62	....	.....	.....	.....	.....	.....	.....	.....

Sizes of Round and Rectangular Flues

Required for the Passage of Given Volumes of Air at Given Velocities

Feet Per Minute		Cubic Feet of Air Per Minute									
		100	200	300	400	500	1000	1500	2000	2500	3000
	Area	46.1	82.3	124	165	206	411	617	823	1028	1234
350	Diam.	8	10	13	15	16	23	28	33	37	40
	Rect.	6 x 8	8 x 12	12 x 12	12 x 14	12 x 18	18 x 24	22 x 28	24 x 36	28 x 38	28 x 44
	Area	36	72	108	144	180	360	540	720	900	1080
400	Diam.	7	10	12	14	16	22	27	31	34	37
	Rect.	6 x 6	8 x 10	10 x 12	12 x 12	12 x 16	18 x 20	20 x 28	24 x 30	28 x 32	28 x 40
	Area	32	64	96	128	160	320	480	640	800	960
450	Diam.	7	10	12	13	15	20	25	29	32	35
	Rect.	6 x 6	8 x 8	8 x 12	12 x 12	12 x 14	16 x 20	20 x 24	24 x 28	28 x 30	28 x 34
	Area	29	58	87	116	144	290	434	580	724	870
500	Diam.	7	9	11	13	14	20	24	28	31	34
	Rect.	6 x 6	8 x 8	8 x 12	10 x 12	12 x 12	16 x 18	20 x 22	24 x 24	26 x 28	28 x 32
	Area	26	52	79	105	131	262	393	524	655	786
550	Diam.	6	9	10	12	13	19	22	26	29	32
	Rect.	6 x 6	8 x 8	8 x 10	10 x 12	10 x 14	16 x 18	20 x 20	22 x 24	24 x 28	28 x 28
	Area	24	48	72	96	120	240	360	480	600	720
600	Diam.	6	8	10	11	13	18	22	25	28	31
	Rect.	4 x 6	6 x 8	6 x 12	8 x 12	10 x 12	16 x 16	18 x 20	20 x 24	24 x 26	26 x 28
	Area	22	44	67	89	112	222	333	442	564	664
650	Diam.	6	8	10	11	12	17	21	24	27	29
	Rect.	4 x 6	6 x 8	6 x 12	8 x 12	10 x 12	14 x 16	18 x 18	20 x 22	24 x 24	26 x 26
	Area	21	42	63	83	103	206	309	410	513	618
700	Diam.	6	8	9	11	12	16	20	23	26	28
	Rect.	4 x 6	6 x 8	6 x 10	8 x 12	10 x 10	14 x 16	16 x 20	20 x 22	22 x 24	24 x 26
	Area	19	39	57	77	96	192	228	384	480	576
750	Diam.	5	8	9	10	11	16	19	22	25	27
	Rect.	4 x 6	6 x 8	6 x 10	8 x 10	10 x 10	14 x 14	16 x 18	20 x 20	22 x 22	24 x 24
	Area	18	36	54	72	90	180	270	360	450	540
800	Diam.	5	7	9	10	11	16	19	22	24	27
	Rect.	4 x 6	6 x 6	6 x 10	8 x 10	8 x 12	14 x 14	16 x 18	18 x 20	22 x 22	24 x 24
	Area	17	34	51	68	85	170	225	340	425	510
850	Diam.	5	7	9	10	11	15	18	21	24	26
	Rect.	4 x 6	6 x 6	6 x 10	8 x 10	8 x 12	14 x 14	16 x 16	18 x 18	20 x 22	22 x 24
	Area	16	32	48	64	80	160	240	320	400	480
900	Diam.	5	7	8	9	11	15	18	21	23	25
	Rect.	4 x 4	6 x 6	6 x 8	8 x 8	8 x 10	12 x 14	16 x 16	18 x 18	20 x 20	22 x 22
	Area	16	31	46	61	76	152	228	304	380	456
950	Diam.	5	7	8	9	10	14	17	20	22	24
	Rect.	4 x 4	6 x 6	6 x 6	8 x 8	8 x 10	12 x 14	14 x 16	18 x 18	20 x 20	22 x 22

Sizes of Round and Rectangular Flues

Required for the Passage of Given Volumes of Air at Given Velocities

Feet Per Minute		Cubic Feet of Air Per Minute									
		100	200	300	400	500	1000	1500	2000	2500	3000
1000	Area	15	29	44	58	72	144	216	288	360	432
	Diam.	5	7	8	9	10	14	17	20	22	24
	Rect.	4 x 4	6 x 6	6 x 8	8 x 8	8 x 10	12 x 12	14 x 16	16 x 18	18 x 20	20 x 22
1050	Area	14	28	42	56	69	138	207	276	345	414
	Diam.	5	6	8	9	10	14	17	19	21	23
	Rect.	4 x 4	6 x 6	6 x 8	8 x 8	8 x 10	12 x 12	14 x 16	16 x 18	18 x 20	20 x 22
1100	Area	13	26	40	53	66	130	195	260	325	390
	Diam.	5	6	8	9	10	13	16	19	21	23
	Rect.	4 x 4	6 x 6	6 x 8	8 x 8	8 x 10	12 x 12	14 x 14	16 x 18	18 x 18	20 x 20
1150	Area	13	25	38	50	62	126	189	251	314	377
	Diam.	5	6	7	8	9	13	16	18	20	22
	Rect.	4 x 4	6 x 6	6 x 8	8 x 8	8 x 8	12 x 12	14 x 14	16 x 16	18 x 18	20 x 20
1200	Area	12	24	36	48	60	120	180	240	300	360
	Diam.	4	6	7	8	9	13	16	18	20	22
	Rect.	4 x 4	4 x 6	6 x 6	6 x 8	8 x 8	10 x 12	12 x 16	16 x 16	18 x 18	18 x 20
1250	Area	12	23	36	46	58	115	173	231	289	347
	Diam.	4	6	7	8	9	13	15	18	20	21
	Rect.	4 x 4	4 x 6	6 x 6	6 x 8	8 x 8	10 x 12	12 x 14	14 x 16	16 x 20	16 x 22

Feet Per Minute		Cubic Feet of Air Per Minute									
		3500	4000	4500	5000	5500	6000	6500	7000	7500	8000
350	Area	1439	1646	1850	2056	2261	2467	2672	2880	3083	3291
	Diam.	43	46	49	52	54	56	59	61	63	65
	Rect.	28 x 52	36 x 46	36 x 52	36 x 58	46 x 50	48 x 52	48 x 56	48 x 60	48 x 66	48 x 70
400	Area	1260	1440	1620	1800	1980	2160	2340	2520	2700	2880
	Diam.	40	43	46	48	51	53	55	57	59	61
	Rect.	28 x 46	30 x 48	36 x 46	36 x 50	42 x 48	42 x 52	42 x 56	48 x 54	48 x 58	48 x 60
450	Area	1120	1280	1440	1600	1760	1920	2080	2240	2400	2560
	Diam.	38	41	43	46	48	50	52	54	56	57
	Rect.	28 x 40	30 x 44	36 x 43	36 x 46	42 x 42	42 x 46	42 x 50	42 x 54	42 x 58	42 x 62
500	Area	1014	1160	1324	1450	1594	1740	1884	2030	2160	2304
	Diam.	36	39	41	43	45	47	49	51	53	55
	Rect.	30 x 34	30 x 40	34 x 40	36 x 42	38 x 42	42 x 42	42 x 46	42 x 50	42 x 52	42 x 56
550	Area	917	1048	1179	1310	1441	1572	1703	1834	1965	2096
	Diam.	35	37	39	41	43	45	47	49	50	52
	Rect.	28 x 34	28 x 38	34 x 36	36 x 38	36 x 40	36 x 44	42 x 42	42 x 44	42 x 48	42 x 50

Sizes of Round and Rectangular Flues

Required for the Passage of Given Volumes of Air at Given Velocities

Feet Per Minute		Cubic Feet of Air Per Minute									
		3500	4000	4500	5000	5500	6000	6500	7000	7500	8000
600	Area	840	960	1080	1200	1320	1440	1560	1680	1800	1920
	Diam.	33	35	38	400	41	43	45	47	48	50
	Rect.	28 x 30	28 x 34	32 x 34	34 x 36	36 x 38	36 x 40	36 x 44	36 x 48	36 x 50	42 x 46
650	Area	774	885	996	1106	1217	1330	1441	1554	1665	1776
	Diam.	33	34	36	38	40	42	43	45	46	48
	Rect.	28 x 28	28 x 32	28 x 36	30 x 36	34 x 36	36 x 38	36 x 40	36 x 44	36 x 46	42 x 44
700	Area	721	824	927	1030	1133	1236	1339	1440	1547	1650
	Diam.	31	33	35	37	38	40	41	43	45	46
	Rect.	26 x 28	28 x 30	28 x 34	30 x 36	30 x 38	30 x 42	36 x 38	36 x 40	36 x 44	36 x 46
750	Area	672	768	864	960	1056	1152	1248	1344	1440	1536
	Diam.	30	32	34	35	37	39	40	42	43	45
	Rect.	24 x 28	28 x 28	28 x 32	30 x 32	32 x 34	34 x 34	36 x 36	36 x 38	36 x 40	36 x 44
800	Area	630	720	810	900	990	1080	1170	1260	1350	1440
	Diam.	29	31	33	34	36	38	39	40	42	43
	Rect.	24 x 26	26 x 28	28 x 30	30 x 30	30 x 34	32 x 34	34 x 36	36 x 36	36 x 38	36 x 40
850	Area	595	680	765	850	935	1020	1105	1190	1275	1360
	Diam.	28	30	32	33	35	36	38	39	41	42
	Rect.	24 x 26	26 x 26	28 x 28	30 x 30	30 x 32	30 x 34	34 x 34	34 x 36	36 x 36	36 x 38
900	Area	560	640	720	800	880	960	1040	1120	1200	1280
	Diam.	27	29	31	32	34	35	37	38	40	41
	Rect.	24 x 24	24 x 26	26 x 28	28 x 30	30 x 30	30 x 32	30 x 36	30 x 38	30 x 40	36 x 36
950	Area	532	608	684	760	836	912	988	1064	1140	1216
	Diam.	26	28	30	31	33	34	36	37	38	40
	Rect.	22 x 24	24 x 26	24 x 30	24 x 32	24 x 36	24 x 38	24 x 42	30 x 36	30 x 38	30 x 42
1000	Area	504	576	648	720	792	864	936	1008	1080	1150
	Diam.	26	28	29	31	32	34	36	36	38	39
	Rect.	22 x 24	22 x 26	24 x 28	24 x 30	24 x 34	24 x 36	24 x 40	30 x 34	30 x 38	30 x 40
1050	Area	483	552	621	690	759	828	897	966	1035	1104
	Diam.	25	27	29	30	31	33	34	35	37	38
	Rect.	20 x 24	22 x 26	24 x 26	24 x 30	24 x 32	24 x 36	24 x 38	24 x 40	24 x 44	30 x 38
1100	Area	455	520	585	650	715	780	845	910	975	1040
	Diam.	24	26	28	29	31	32	33	34	36	37
	Rect.	20 x 24	22 x 24	24 x 26	24 x 28	24 x 30	24 x 34	24 x 36	24 x 38	24 x 42	24 x 44
1150	Area	440	503	566	629	692	755	814	877	940	1003
	Diam.	24	26	27	29	30	31	32	34	35	36
	Rect.	20 x 22	22 x 22	24 x 24	24 x 26	24 x 30	24 x 32	24 x 34	24 x 38	24 x 40	24 x 42
1200	Area	420	480	540	600	660	720	780	840	900	960
	Diam.	24	25	27	28	29	31	32	33	34	36
	Rect.	20 x 22	22 x 22	24 x 24	24 x 26	24 x 28	24 x 30	24 x 34	24 x 36	24 x 38	24 x 40

Standard Data
Measurements of Circles

Diameter	Circum-ference	Area	Diameter	Circum-ference	Area	Diameter	Circum-ference	Area
⅛	.3927	0.0123	16	50.265	201.06	54	169.646	2290.2
¼	.7854	0.0491	½	51.836	213.82	55	172.788	2375.8
⅜	1.1781	0.1104	17	53.407	226.98	56	175.929	2463.0
½	1.5708	0.1963	½	54.978	240.52	57	179.071	2551.7
⅝	1.9635	0.3067	18	56.549	254.46	58	182.212	2642.0
¾	2.3562	0.4417	½	58.119	268.80	59	185.354	2733.9
⅞	2.7489	0.6013	19	59.690	283.52	60	188.496	2827.4
			½	61.261	298.64	61	191.637	2922.4
1	3.1416	0.7854	20	62.832	314.16	62	194.779	3019.0
⅛	3.5343	0.9940	½	64.403	330.06	63	197.920	3117.2
¼	3.9270	1.227	21	65.973	346.36	64	201.062	3216.9
⅜	4.3197	1.484	½	67.544	363.05	65	204.204	3318.3
½	4.7124	1.767	22	69.115	380.13	66	207.345	3421.2
⅝	5.1051	2.073	½	70.686	397.60	67	210.487	3525.6
¾	5.4978	2.405	23	72.257	415.47	68	213.628	3631.6
⅞	5.8905	2.761	½	73.827	433.73	69	216.770	3739.2
			24	75.398	452.39	70	219.911	3848.4
2	6.2832	3.141	½	76.969	471.43	71	223.053	3959.2
¼	7.0686	3.976						
½	7.8540	4.908	25	78.540	490.87	72	226.195	4071.5
¾	8.6394	5.939	26	81.681	530.93	73	229.336	4185.3
			27	84.823	572.55	74	232.478	4300.8
3	9.4248	7.068	28	87.965	615.75	75	235.619	4417.8
¼	10.210	8.295	29	91.106	660.52	76	238.761	4536.4
½	10.996	9.621	30	94.248	706.86	77	241.903	4656.0
¾	11.781	11.044	31	97.389	754.76	78	245.044	4778.3
4	12.566	12.566	32	100.531	804.24	79	248.186	4901.6
½	14.137	15.904	33	103.673	855.30	80	251.327	5026.5
			34	106.814	907.92	81	254.469	5153.0
5	15.708	19.635	35	109.956	962.11	82	257.611	5281.0
½	17.279	23.758	36	113.097	1017.8	83	260.752	5410.6
6	18.850	28.274	37	116.239	1075.2	84	263.894	5541.7
½	20.420	33.183	38	119.381	1134.1	85	267.035	5674.5
7	21.991	38.484	39	122.522	1194.5	86	270.177	5808.8
½	23.562	44.178	40	125.664	1256.6	87	273.319	5944.6
8	25.133	50.265	41	128.805	1320.2	88	276.460	6082.1
½	26.704	56.745						
9	28.274	63.617	42	131.947	1385.4	89	279.602	6221.1
½	29.845	70.882	43	135.088	1452.2	90	282.743	6361.7
10	31.416	78.54	44	138.230	1520.5	91	285.885	6503.8
½	32.987	86.59	45	141.372	1590.4	92	289.027	6647.6
11	34.558	95.03	46	144.513	1661.9	93	292.168	6792.9
½	36.128	103.86						
12	37.699	113.09	47	147.655	1734.9	94	295.310	6939.7
½	39.270	122.71	48	150.796	1809.5	95	298.451	7088.2
13	40.841	132.73	49	153.938	1885.7	96	301.593	7238.2
½	42.412	143.13	50	157.080	1963.5	97	304.734	7389.8
14	43.982	153.93	51	160.221	2042.8	98	307.876	7542.9
½	45.553	165.13						
15	47.124	176.71	52	163.363	2123.7	99	311.018	7697.7
½	48.695	188.69	53	166.504	2206.1	....	....	....

Standard Data

Decimal Equivalents of Fractions

Fraction	Equivalent	Fraction	Equivalent	Fraction	Equivalent	Fraction	Equivalent
1-64	0.015625	17-64	0.265625	33-64	0.515625	49-64	0.765625
1-32	0.031250	9-32	0.281250	17-32	0.531250	25-32	0.781250
3-64	0.046875	19-64	0.296875	35-64	0.546875	51-64	0.796875
1-16	0.062500	5-16	0.312500	9-16	0.562500	13-16	0.812500
5-64	0.078125	21-64	0.328125	37-64	0.578125	53-64	0.828125
3-32	0.093750	11-32	0.343750	19-32	0.593750	27-32	0.843750
7-64	0.109375	23-64	0.359375	39-64	0.609375	55-64	0.859375
1-8	0.125000	3-8	0.375000	5-8	0.625000	7-8	0.875000
9-64	0.140625	25-64	0.390625	41-64	0.640625	57-64	0.890625
5-32	0.156250	13-32	0.406250	21-32	0.656250	29-32	0.906250
11-64	0.171875	27-64	0.421875	43-64	0.671875	59-64	0.921875
3-16	0.187500	7-16	0.437500	11-16	0.687500	15-16	0.937500
13-64	0.203125	29-64	0.453125	45-64	0.703125	61-64	0.953125
7-32	0.218750	15-32	0.468750	23-32	0.718750	31-32	0.968750
15-64	0.234375	31-64	0.484375	47-64	0.734375	63-64	0.984375
1-4	0.250000	1-2	0.500000	3-4	0.750000	1-	1.000000

Miscellaneous Equivalents

Diameter	× 3.1416	=	Circumference
Circumference	× .3183	=	Diameter
Diameter^2	× .7854	=	Area of circle
Area of Circle	× 1.2732	=	Area of circumscribed square
Area of Circle	× .63662	=	Area of inscribed square
Diameter of Circle	× .88623	=	Side of equal square
Diameter of Circle	× .7071	=	Side of inscribed square
Circumference of circle	× 1.1284	=	Perimeter of equal square
Side of square	= 1.4142	=	Diameter of circumscribed circle
Side of square	× 1.1284	=	Diameter of equal circle
Perimeter of square	× .88623	=	Circumference of equal circle
Diameter^2	× 3.1416	=	Surface of sphere
Diameter^3	× .5236	=	Volume of sphere
Diameter of sphere	× .806	=	Dimensions of equal cube
Diameter of sphere	× .6667	=	Length of equal cylinder
Area of base	× ⅓ height	=	Volume of pyramid or cone
Base	× ½ height	=	Area of triangle
Radius	× 1.1547	=	Side of inscribed cube
Square inches	× 1.2732	=	Circular inches
Square inches	× .00695	=	Square feet
Square feet	× .111	=	Square yard
Square yards	× .0002066	=	Acres
Cubic inches	× .00058	=	Cubic feet
Cubic feet	× .03704	=	Cubic yards
Cubic inches	× .004329	=	U. S. gallons
Cubic feet	× 7.4805	=	U. S. gallons
Cubic inches	× .000466	=	U. S. bushels
Cubic feet	× .8036	=	U. S. bushels
U. S. bushels	× 2150.42	=	Cubic inches
U. S. bushels	× 1.242	=	Cubic feet
U. S. bushels	× .046	=	Cubic yards
U. S. gallons	× 231.	=	Cubic inches
U. S. gallons	× .13368	=	Cubic feet
Cubic inches water	× .36127	=	Pounds (avoirdupois)
Cubic feet water	× 62.4283	=	Pounds (avoirdupois)
U. S. gallons water	÷ 268.8	=	Tons
Column of water 1″ diameter x 12″ high		=	.34 lb. (avoirdupois)
Cubic inches	× .263	=	Lb. Av. Cast Iron
Cubic inches	× .281	=	Lb. Av. Wrought Iron
Cubic inches	× .283	=	Lb. Av. Cast Steel
Cubic inches	× .3225	=	Lb. Av. Copper
Cubic inches	× .3037	=	Lb. Av. Brass
Cubic inches	× .26	=	Lb. Av. Zinc
Cubic inches	× .4103	=	Lb. Av. Lead
Cubic inches	× .2636	=	Lb. Av. Tin
Cubic inches	× .4908	=	Lb. Av. Mercury
12 × weight of pine pattern		=	Iron casting
13 × weight of pine pattern		=	Brass casting
14 × weight of pine pattern		=	Lead casting

Standard Data

Miscellaneous Equivalents

1 calorie	=	3.968 B.t.u.
1 B.t.u.	=	0.252 calorie
1 lb. per sq. in.	=	703.08 kilogrammes per m^2
1 kilogramme per m^2	=	0.00142 lbs. per sq. in.
1 calorie per m^2	=	0.3687 B.t.u. per sq. ft
1 B.t.u. per sq. ft	=	2.712 calories per m^2
1 calorie per m^2 per deg. difference cent.	=	0.2048 B.t.u. per sq. ft. per deg. difference fahr.
1 B.t.u. per sq. ft. per deg. difference fahr.	=	4.882 calories per m^2 per deg. difference cent.
1 B.t.u. per lb.	=	0.556 calories per kilog.
1 calorie per kilog.	=	1.8 B.t.u. per lb.
1 litre of coke at 26.3 lb. per cu. ft.	=	0.93 lbs.
1 lb. of coke at 26.3 per cu. ft.	=	1.076 litres.
Water expands in bulk from 40 deg. to 212 deg.	=	1/23
1 cu. in. of Cast Iron	weighs	0.260 lb.
1 cu. in. of Wrought Iron	weighs	0.280 lb.
1 cu. in of Water	weighs	0.036 lb.
1 U. S. gal.	weighs	8.330 lb.
1 Imperial gal.	weighs	10. lb.
1 U. S. gal.	=	231. cu. in.
1 Imperial gal.	=	277.274 cu. in.
1 cu. ft. of Water	=	7.480 U. S. gal.
1 lb. of Steam	=	27.222 cu. ft.
1 lb. of Air	=	13.817 cu. ft.

SURVEYORS MEASURE

7.92 in.	1 link
25 links, 1 rod; 4 rods	1 chain
10 sq. chains or 160 sq. rods	1 acre
640 acres	1 sq. mile
36 sq. miles (6 miles sq.)	1 township

CUBIC MEASURE

1728 cu. in.	1 cu. ft.
128 cu. ft.	1 cord (wood)
27 cu. ft.	1 cu. yd.
40 c. f.	1 ton (shpg)
2150.42 cu. in.	1 standard bu.
231 cu. in.	1 U. S. standard gal.
1 cu. ft.	about 4/5 of a bu.

Metric and English Measures

MEASURES OF LENGTH

1	meter	=	39.37	in.
			3.28	ft.
.3048	meter	=	1	ft.
1	centimeter	=	.3937	in.
2.54	centimeters	=	1	in.
1	millimeter	=	.03937	in. (1/25 in., nearly)
25.4	millimeters	=	1	in.
1	kilometer.	=	1093.61	yds.

MEASURES OF SURFACE

1	sq. meter	=	10.764	sq. ft.
.0929	sq. meter	=	1	sq. ft.
1	sq. centimeter	=	.155	sq. in.
6.452	sq. centimeters	=	1	sq. in.
1	sq. millimeter	=	.00155	sq. in.
645.2	sq. millimeters	=	1	sq. in.

1 sq. decimeter	0.1076	sq. ft.
1 sq. meter	1.196	sq. yard
1 are	3.954	sq. rods
1 hectare	2.47	acres
1 sq. kilometer	0.386	sq. m.
1 sq. in.	6.452	sq. centimeters
1 sq. ft.	9.2903	sq. decimeters
1 sq. yd.	0.8361	sq. m'r
1 sq. rd.	0.2529	are
1 acre	0.4047	hectare
1 sq. m.	2.59	sq. kilometers

MEASURES OF VOLUME

1	cu. meter	=	35.314	cu. ft.
.02832	cu. meter	=	1	cu. ft.
1	cu. decimeter	=	61.023	cu. in.
			.0353	cu. ft.
28.32	cu. decimeters	=	1	cu. ft.
16.387	cu. centimeters	=	1	cu. in.
1	cu. centimeter	=	1	millimeter
			.061	cu. in.

MEASURES OF CAPACITY

1	litre = cubic decimeter	=	61.023	cu. in.
			.0353	cu. ft.
			.2202	gal. (Imperial)
			2.202	lb. of water at 62 deg. fahr.
28.317	litres	=	1	cu. ft. (6.25 Imperial gal.)
4.543	litres	=	1	gal. (Imperial)
3.785	litres	=	1	gal. (American)

MEASURES OF WEIGHT

28.35	grammes	=	1	oz. avoirdupois
1	kilogramme	=	2.2046	lb.
.4536	kilogramme	=	1	lb.
1 / 1000	metric ton / kilogrammes	=	.9842 / 19.68	ton of 2240 lb., or cwts. or 2204.6 lb.
1.016 / 1016	metric tons / kilogrammes	=		1 ton of 2240 lb.

1 gram	0.03527	ounce
1 kilogram	2.2046	lbs.
1 metric ton	1.1023	English tons
1 oz.	28.35	grams
1 lb.	0.4536	kilogram
1 English ton	0.9072	metric ton

MISCELLANEOUS

1	gramme per sq. millimeter	=	1.422	lb. per sq. in.
1	kilogramme per sq. millimeter	=	1422.32	lb. per sq. in.
1	kilogramme per sq. centimeter	=	14.233	lb. per sq. in.
1.0335	kg. per sq. centimeter 1 atmosphere	=	14.7	lb. per sq. in.
0.070308	kilogramme per sq. centimeter	=	1	lb. per sq. in.

Standard Data

Miscellaneous

MEASURES OF PRESSURE AND WEIGHT

1 lb. per sq. in...... =	144.	lb. per sq. ft.
	2.0355	in. at mercury of 32 deg. fahr.
	2.0416	in. of mercury at 62 deg. fahr.
	2.309	ft. of water at 62 deg. fahr.
	27.71	in. of water at 62 deg. fahr.
1 Atmosphere (14.7 lb. per sq. in.) =	2116.3	lb. per sq. ft.
	33.947	ft. of water at 62 deg. fahr.
	30	in. of mercury at 62 deg. fahr.
	29.922	in. of mercury at 32 deg. fahr.
	760	millimetres of mercury at 32 deg. fahr.
1 ft. of Water at 62 deg. fahr...... =	0.433	lb. per sq. in.
	62.355	lb. per sq. ft.
1 in. of Mercury at 62 deg. fahr......=	0.491	lb. or 7.86 oz. per sq. in.
	1.132	ft. of water at 62 deg. fahr.
	13.58	in. of water at 62 deg. fahr.

WEIGHT OF ONE CUBIC FOOT OF PURE WATER

At 32 deg. fahr. (freezing point)................62.418 lb.
At. 39.1 deg. fahr, (maximum density)..........62.425 lb.
At 62 deg. fahr. (standard temperature).........62.355 lb.
At 212 deg. fahr. (boiling point, under 1 atmosphere).....................................59.76 lb.
Imperial gal.= 277.274 cu. in. of water at 62 deg. fahr......................................10 lb.
American gal.= 231 cu. in. of water at 62 deg. fahr.................................... = 8.3356 lb.

BOILING POINTS OF VARIOUS FLUIDS

	Degrees Fahr.		Degrees Fahr.
Water, Atmospheric Pressure	212	Refined Petroleum	316
Alcohol	173	Turpentine	315
Sulphuric Acid	240	Sulphur	570
		Linseed Oil	497

MELTING POINTS OF DIFFERENT METALS

	Degrees Fahr.		Degrees Fahr.
Aluminum	1400	Iron (cast)	2450
Antimony	810	Iron (wrought)	2912
Bismuth	476	Lead	608
Brass	1900	Platinum	3080
Bronze	1692	Silver (pure)	1873
Copper	1996	Steel	2500
Glass	2377	Tin	446
Gold (pure)	2590	Zinc	680

Weights and Measures

TROY WEIGHT

24 grains..1 pwt.
20 pwt...1 oz.
12 oz...1 lb.

Used for weighing gold, silver and jewels.

APOTHECARIES WEIGHT

20 grains...1 scruple
3 scruples..1 dram
8 drams...1 ounce
12 ounces...1 pound

Ounce and pound are the same as in Troy Weight.

AVOIRDUPOIS WEIGHT

27 11/32 grains	1 dram	4 quarters	1 cwt.
16 drams	1 ounce	2,000 lb.	1 short ton
16 ounces	1 pound	2,240 lb.	1 long ton
25 pounds	1 quarter		

DRY MEASURE

2 pints	1 qt.	4 pecks	1 bushel
8 quarts	1 peck	36 bushels	1 chaldron

LIQUID MEASURE

4 gills	1 pint	31½ gallons	1 barrel
2 pints	1 quart	2 barrels	1 hogshead
4 quarts	1 gallon		

LONG MEASURE

12 inches	1 foot	40 rods	1 furlong
3 feet	1 yard	8 furlongs	1 sta. mile
5½ yards	1 rod	3 miles	1 league

CLOTH MEASURE

2¼ inches	1 nail	4 quarters	1 yard
4 nails	1 quarter		

SQUARE MEASURE

144 sq. inches	1 sq. foot	40 sq. rods	1 rood
9 sq. feet	1 sq. yard	4 roods	1 acre
30¼ sq. yd	1 sq. rod	640 acres	1 sq. mile

INDEX

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